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 ROKU, INC.

FILED

MAY 04 2020

SUSAN Y. SOONG
 CLERK, U.S. DISTRICT COURT
 NORTH DISTRICT OF CALIFORNIA

UNITED STATES DISTRICT COURT
 FOR THE NORTHERN DISTRICT OF CALIFORNIA

JSC

CV 20

80080MISC

CANON, INC.,

Plaintiff,

v.

TCL ELECTRONICS HOLDINGS LTD.,
 ET AL.,

Defendants.

)
)
) **DECLARATION OF ANDREW T. RADSCH**
) **IN SUPPORT OF NON-PARTY ROKU,**
) **INC.'S MOTION TO MODIFY OR QUASH**
) **PLAINTIFF CANON INC.'S SUBPOENA**
) **AND FOR A PROTECTIVE ORDER**
)
)
)
)
)

I, Andrew T. Radsch, declare as follows:

1. I am a partner at the law firm of Ropes & Gray LLP, counsel to non-party Roku, Inc. ("Roku") in the above-captioned matter.

2. I am admitted to practice in the State of California, and I am admitted before the U.S. District Court for the Northern District of California.

3. I submit this declaration in support of Roku's Motion to Modify or Quash Plaintiff Canon, Inc.'s ("Canon") Subpoena and for a Protective Order, submitted concurrently

1 herewith. The facts set forth in this declaration are known to me personally, and if called upon I
2 could competently testify to them.

3 4. For use in the ongoing case of *Canon, Inc. v. TCL Elecs. Holdings Ltd.*, Case No.
4 2:18-CV-00546-JRG (E.D. Tex.), Canon has served two document subpoenas on Roku, totaling
5 46 broad requests for production; two subpoenas for the deposition of Roku, totaling 26 topics;
6 and subpoenas for the testimony of seventeen individual Roku employees.

7 5. A true and correct copy of Roku's publicly available 2019 Form 10-K is attached
8 hereto as **Exhibit A**.

9 6. A true and correct copy of Canon's Subpoena to Produce Documents,
10 Information, or Objects or to Permit Inspection of Premises in a Civil Action, dated December
11 20, 2019, and served on Roku on December 23, 2019, is attached hereto as **Exhibit B**.

12 7. A true and correct copy of a January 13, 2020 letter from me to Yar Chaikovsky,
13 counsel for Canon, containing Roku's objections and responses to Canon's December 23, 2019
14 Subpoena to Produce Documents, Information, or Objects or to Permit Inspection of Premises in
a Civil Action, is attached hereto as **Exhibit C**.

15 8. A true and correct copy of email communications between me and Alexander H.
16 Lee, counsel for Canon, between December 20, 2019 and January 26, 2020 is attached hereto as
17 **Exhibit D**.

18 9. A true and correct copy of email communications between me and Andy
19 LeGolvan, counsel for Canon, between April 22, 2020 and April 24, 2020 is attached hereto as
20 **Exhibit E**.

21 10. A true and correct copy a document bearing Bates number ROKU-
22 CANON_0000025253 is attached hereto as **Exhibit F**. This document is designated
23 "RESTRICTED – ATTORNEYS' EYES ONLY" pursuant to the Protective Order in *Canon,*
24 *Inc. v. TCL Elecs. Holdings Ltd.*, Case No. 2:18-CV-00546-JRG (E.D. Tex.), Dkt. No. 79, and is
25 filed under seal.

26 11. A true and correct copy of U.S. Patent No. 7,746,413 is attached hereto as
27 **Exhibit G**.

12. A true and correct copy of U.S. Patent No. 7,810,130 is attached hereto as

Exhibit H.

13. A true and correct copy of U.S. Patent No. 8,078,767 is attached hereto as

Exhibit I.

14. A true and correct copy of U.S. Patent No. 8,346,986 is attached hereto as

Exhibit J.

15. A true and correct copy of U.S. Patent No. 8,713,206 is attached hereto as

Exhibit K.

16. A true and correct copy of email communications between me and Andy
LeGolván, counsel for Canon, from April 22, 2020 and April 30, 2020 is attached hereto as

Exhibit L.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 30th day of April, 2020 in Redwood City, California.



Andrew T. Radsch

**UNITED STATES
SECURITIES AND EXCHANGE COMMISSION**
Washington, D.C. 20549

Form 10-K

☒ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the year ended December 31, 2019

or

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

Commission file number: 001-38211

ROKU, INC.

(Exact name of Registrant as specified in its charter)

Delaware
(State or other jurisdiction of
incorporation or organization)

4841
(Primary standard industrial
code number)

26-2087865
(I.R.S. employer identification no.)

150 Winchester Circle
Los Gatos, California 95032
(408) 556-9040

(Address, including zip code, and telephone number, including area code, of Registrant's principal executive offices)

Securities registered pursuant to Section 12(b) of the Act:

Title of each class
Class A Common Stock, \$0.0001 par value

Trading Symbol(s)
ROKU

Name of each exchange on which registered
The Nasdaq Global Select Market

Securities registered pursuant to Section 12(g) of the Act:
None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☐ No ☒

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No ☒

Indicate by check mark whether the registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☒ No ☐

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes ☒ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company" and "emerging growth company" in Rule 12b-2 of the Exchange Act:

Large accelerated filer ☒
Non-accelerated filer ☐
Emerging Growth Company ☐

Accelerated Filer ☐
Smaller reporting company ☐

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Act). Yes ☐ No ☒

As of June 30, 2019, the aggregate market value of voting stock held by non-affiliates of the registrant, based upon the closing sales price for the registrant's common stock, as reported in the Nasdaq Global Select Market System, was \$7,714,110,102. Shares of common stock beneficially owned by each executive officer and director of the Registrant and by each person known by the Registrant to beneficially own 10% or more of the outstanding common stock have been excluded in that such persons may be deemed to be affiliates. This determination of affiliate status is not necessarily a conclusive determination for any other purpose.

As of January 31, 2020, the registrant had 94,759,950 shares of Class A common stock, \$0.0001 par value per share and 25,218,517 shares of Class B common stock, \$0.0001 par value per share.

DOCUMENTS INCORPORATED BY REFERENCE

Part III incorporates by reference certain information from the Registrant's definitive proxy statement (the "2019 Proxy Statement") for the 2020 Annual Meeting of Stockholders. The 2019 Proxy Statement will be filed with the Securities and Exchange Commission within 120 days of the registrant's fiscal year ended December 31, 2019.

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NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K contains forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, or the Securities Act, and Section 21E of the Securities Exchange Act of 1934, as amended, or the Exchange Act, about us and our industry that involve substantial risks and uncertainties. All statements other than statements of historical facts contained in this report, including statements regarding our future results of operations and financial condition, business strategy and plans and objectives of management for future operations, are forward-looking statements. In some cases, forward-looking statements may be identified by words such as “anticipate,” “believe,” “continue,” “could,” “design,” “estimate,” “expect,” “intend,” “may,” “plan,” “potentially,” “predict,” “project,” “should,” “will” or the negative of these terms or other similar expressions.

Forward-looking statements are based on our management’s beliefs and assumptions and on information currently available. These forward-looking statements are subject to a number of known and unknown risks, uncertainties and assumptions, including risks described in the section titled “Risk Factors” and elsewhere in this Form 10-K, regarding, among other things:

- our financial performance, including our revenue, cost of revenue, operating expenses and our ability to attain and sustain profitability;
- our ability to attract and retain users and increase streaming hours;
- our ability to attract and retain advertisers;
- our ability to attract and retain TV brands and service operators to license and deploy our technology;
- our ability to acquire rights to distribute popular content on our platform on favorable terms, or at all, including the renewals of our existing agreements with content publishers;
- changes in consumer viewing habits and the growth of TV streaming;
- the growth of our relevant markets, including the growth in advertising spend on TV streaming platforms, and our ability to successfully grow our business in those markets;
- our ability to adapt to changing market conditions and technological developments, including developing integrations with our platform partners;
- our ability to develop and launch new streaming products and provide ancillary services and support;
- our ability to integrate the business and operations of dataxu, Inc., a demand-side platform (“DSP”) company that we recently acquired;
- our ability to compete effectively with existing competitors and new market entrants;
- our ability to successfully manage domestic and international expansion;
- our ability to attract and retain qualified employees and key personnel;
- our abilities to address potential and actual security breaches and system failures involving our products, systems and operations;
- our ability to maintain, protect and enhance our intellectual property; and
- our ability to comply with laws and regulations that currently apply or may become applicable to our business both in the United States and internationally, including compliance with the EU General Data Protection Regulation and the California Consumer Privacy Act.

We caution you that the foregoing list may not contain all of the forward-looking statements made in this Annual Report on Form 10-K.

Other sections of this report may include additional factors that could harm our business and financial performance. Moreover, we operate in a very competitive and rapidly changing environment. New risk factors emerge from time to time, and it is not possible for our management to predict all risk factors nor can we assess the impact of all factors on our business or the extent to which any factor, or combination of factors, may cause actual results to differ from those contained in, or implied by, any forward-looking statements.

You should not rely upon forward-looking statements as predictions of future events. We cannot assure you that the events and circumstances reflected in the forward-looking statements will be achieved or occur. Although we believe that the expectations reflected in the forward-looking statements are reasonable, we cannot guarantee future results, levels of activity, performance or achievements. Except as required by law, we undertake no obligation to update publicly any forward-looking statements for any reason after the date of this report or to conform these statements to actual results or to changes in our expectations. You should read this Annual Report on Form 10-K and the documents that we reference in this Annual Report on Form 10-K and have filed as exhibits to this report with the understanding that our actual future results, levels of activity, performance and achievements may be materially different from what we expect. We qualify all of our forward-looking statements by these cautionary statements.

Investors and others should note that we may announce material business and financial information to our investors using our investor relations website (ir.roku.com/investor-relations), SEC filings, webcasts, press releases, and conference calls. We use these mediums, including our website, to communicate with investors and the general public about our company, our products, and other issues. It is possible that the information that we make available may be deemed to be material information. We therefore encourage investors and others interested in our company to review the information that we make available on our website.

PART I

Item 1: Business

Overview

Roku, Inc. (“Roku”, “the Company”, “we” or “us”) is the leading TV streaming platform in the U.S. by hours streamed. Our active accounts increased to 36.9 million at December 31, 2019, and our users streamed 40.3 billion hours of content during 2019.

We pioneered streaming to the TV and were founded on the belief that someday all TV content would be streamed. The re-platforming of the TV ecosystem from traditional linear TV distribution and legacy pay TV services that started when early adopters began embracing TV streaming has gained momentum rapidly and is creating even more opportunities for consumers, content publishers, advertisers and other industry participants. Over the last year, many of the biggest names in media and TV programming embraced the transition to streaming resulting in the launch of new TV streaming services, growing investment in original content that is exclusive to streaming, and more ad-supported TV viewing options. As TV streaming has become mainstream, consumers are spending more time watching TV streaming services, with many leaving legacy pay TV services entirely. We believe that as the shift to TV streaming continues, advertisers looking to reach and engage streaming audiences will take advantage of the benefits inherent with digital advertising capabilities available in TV streaming and will re-allocate their budgets accordingly. We are capitalizing on this large and growing economic opportunity.

Our Strategy

Our mission is to be the streaming platform that connects the entire TV ecosystem. Through our TV streaming platform, we are focused on connecting users to the streaming content they love, enabling content publishers to build and monetize large audiences, and providing advertisers with unique capabilities to engage consumers. Central to our platform is the Roku operating system (the “Roku OS”). The Roku OS is purpose built for TV to run on low-cost hardware which enables us to manufacture and sell affordable streaming players. The Roku OS also powers Roku TV models that are manufactured and sold by our TV brand partners who license the Roku OS and leverage our smart TV hardware reference designs. We also license the Roku OS and our streaming player designs, and provide ongoing technology and support services, to certain international service operators that distribute Roku Powered players to their subscribers. All Roku devices – Roku streaming players, Roku TVs and Roku Powered streaming players – enable users to access a wide selection of content by connecting their Roku device to our streaming platform via a home broadband network.

The Roku OS provides much of the core functionality of Roku devices, integrates our streaming software, user interface and advertising technology, and provides content publishers and advertisers with access to our billing services and data insight tools. The features and functionality of our platform along with the Roku OS enable us to address the needs of our users, content publishers, advertisers, Roku TV brand partners and other licensees. We continue to invest significant resources to advance the Roku OS and to provide an industry-leading platform for our users, content publishers and advertisers.

Our Business Model

Three core activities drive our business model. We focus on increasing the number of active accounts that use our streaming platform to watch TV, increasing user engagement and growing the hours of content streamed, and growing our revenue and gross profit by monetizing user activity on our platform.

To increase the number of active accounts on our platform, we sell stand-alone streaming players, we work with TV brand partners who license the Roku OS to manufacture and sell Roku TV models, and we also license the Roku OS to certain service operators. These various account acquisition paths allow consumers to access the Roku platform in multiple ways. Our Roku TV licensing program has experienced strong growth and for the year ended December 31, 2019 nearly 1 in 3 smart TVs sold in the United States was a Roku TV. To attract and retain active accounts, we also invest significant resources to improve the user experience on our streaming platform. This includes improvements to our navigation functions and search and discovery feature as well as increasing the depth

and breadth of our content offering and enhancing the overall streaming experience. In 2019, we increased our active accounts by 9.8 million to reach 36.9 million active accounts at year end.

We believe that offering users a wide range of content and running more relevant display and digital ads enhances the user experience on our platform and drives increased user engagement by delivering a better overall streaming experience. We offer our users a rich content selection that is easy to find and discover, and we seek to run relevant digital ads on our platform that enhance the user's experience. We enable our content partners to publish streaming channels, quickly and easily, which makes us an attractive platform for content publishers to partner with as they seek to reach TV streaming, or over-the-top ("OTT"), users. Streaming hours on our platform have grown from 24.0 billion hours in 2018 to 40.3 billion hours in 2019, as we have grown active accounts through the distribution of streaming players and Roku TVs, and as our active accounts stream more hours per day, on average. While the number of hours streamed on our platform reflects our popularity and brand affinity, it does not correlate to platform segment gross revenue or the average revenue per user ("ARPU") on a period by period basis.

We generate revenue by monetizing our users' engagement on our platform through a variety of services and capabilities, including video advertising in ad supported channels, sales of subscription services and other commerce transactions, brand sponsorship and promotions, and billing services. We measure monetization of our platform by calculating the ARPU, which we believe represents the inherent value of our business model, and growth in gross profit. In 2019, ARPU (which we measure on a trailing twelve-month basis) increased from \$17.95 to \$23.14 and gross profit for the full year grew from \$332.1 million to \$495.2 million.

Serving the Needs of our Users, Content Publishers, Advertisers and other Industry Participants

Our business model is designed to addresses the needs of the participants in the TV streaming ecosystem.

Users

Through our streaming platform and our streaming devices, we make it easy and affordable for our users to watch their favorite TV shows and movies, as well as listen to streaming audio. We believe our platform offers users an incredible streaming experience through a user interface that is easy to use and navigate. From the Roku home screen, our users can access the 500,000+ free and paid movies and TV episodes including live TV, news, sports, hit movies, popular shows and more that are available from thousands of channels on our streaming platform. Roku's powerful cross-channel search capabilities make it simple for our users to find TV episodes, movies and other content across a wide variety of channels. Users are able to control the amount that they spend on streaming content by choosing content that is available on an ad-supported, subscription or transactional basis.

Our direct relationship with our users provides us with detailed insights about our users and their behavior on our platform, including the channels that they install, the content they search for, the channels they watch, and certain content that they purchase or subscribe to on our platform. Our first party data enables us to develop actionable insights such as unbiased search results and content recommendations to improve our users' experience.

We make TV streaming affordable by offering a lineup of stand-alone streaming players that connect to a user's TV. Released in the fall of 2019, our current streaming player lineup has manufacturer suggested retail prices ranging from \$29.99 to \$99.99. We also partner with TV brands that manufacture and sell co-branded Roku TV models. Furthermore, to enhance our users' experience and to provide a better audio experience we also offer our Roku wireless speakers that connect to a Roku TV, Roku Smart Soundbars with a streaming player built in that enables the soundbar to connect to our streaming platform, and wireless Roku Wireless Subwoofers.

Content Publishers

We enable content publishers to build audiences and monetize their content on our streaming platform. Content publishers can deliver content directly to our large and relevant audiences and reach those users who no longer use or those who never used linear TV or paid TV subscriptions. As consumers shift to TV streaming, content publishers that use our platform are able to reach these streaming audiences at scale and engage users directly. We make it easy for content publishers to distribute and monetize their streaming content through three primary business models, transaction video on demand ("TVOD"), subscription video on demand ("SVOD"), and advertising

supported video on demand ("AVOD"). Through our platform we are also able to assist content partners with billing services, including billing customers for in-channel purchases like a movie rental, managing subscriptions and customer invoices.

Content publishers also have access to our promotional and audience development tools to help them attract and retain viewers. Content publishers can use a variety of ad placements, including native display ads on the Roku home screen or a screen saver to drive channel downloads, promote a channel's content, and direct traffic to their channels in order to drive subscriptions or movie and TV show consumption. We also sell branded channel buttons on streaming player and Roku TV remote controls that are intended to increase incremental usage of the channel by allowing users to launch straight into the channel from the home screen. Our analytics and reporting assist content publishers with analyzing viewership trends and metrics for specific titles. Using machine learning, we also can help content publishers target new audiences that are more likely to subscribe to their services.

In 2017, we launched The Roku Channel as our own streaming channel that drives user engagement on our platform by providing our users free ad-supported access to a large library of third-party content that we directly license, in addition to content made available through The Roku Channel by our content publishers. The Roku Channel provides monetization for both our content partners and Roku through digital advertising. The Roku Channel also is intended to help content publishers drive additional viewership of their content on our platform by making their content available in The Roku Channel. The Roku Channel has grown from providing our users with free access to 1,000 movies and TV episodes to over 10,000 hit Hollywood movies, TV shows, news and more and is rapidly becoming one of our leading sources of advertising inventory. To further drive user engagement, in January 2019, we launched Premium Subscriptions within The Roku Channel, through which we resell ad-free premium content subscription services from providers such as HBO, Showtime, Starz and Epix directly to our users. In addition to a mix of free and subscription based content, The Roku Channel includes marketing tools that are designed to recruit and retain users. During 2019, we launched personalized content selection for users and integrated The Roku Channel into our billing services to enable one-click subscriptions.

Advertisers

Our sophisticated and leading streaming platform enables advertisers, including content publishers, brands and agencies, to reach audiences that are no longer reachable or are increasingly unavailable through traditional advertising on linear TV. Using our tools and advertising platform, advertisers are able to leverage our direct relationship with our users, as well as our user data and insights, to serve relevant, targeted advertisements. Advertisers on our platform also can measure both the effectiveness of the ads served and their return on investment. We also offer engagement analytics such as ad impressions served, click-through rates and video completion rates. We work with a wide variety of third-party measurement companies to measure the branding impact of the ads served and audience demographics, validate ad effectiveness, and quantify sales lift from advertising on our platform. Furthermore, we have relationships with third-party providers that focus on transactional or point of sale data, which enables our advertisers to compare the effectiveness of ads served on our platform to traditional advertising on linear TV. Additional promotional advertising opportunities include content sponsorships to give users the opportunity to experience a free movie or show (e.g. "Family movie night brought to you by...") and sponsored themes on our home screen. We also sell branded content rows within The Roku Channel.

Through our recent acquisition of dataxu, we significantly expanded our advertising capabilities to include TV-centric planning and buying toolset, and automated bidding and self-serve software solutions to manage ad campaigns programmatically across digital platforms. These capabilities, along with our direct relationships with users, growing scale and proprietary first party-data, allow us to provide advertisers with a differentiated and valuable suite of advertising products and services.

Other Industry Participants

Co-branded Roku TV models that integrate the Roku OS that enable basic TV functions and connect to our TV streaming platform are manufactured and sold by TV brands. Using our hardware reference designs enables our TV brand licensees to manufacture and sell smart TVs that have relatively low hardware costs resulting in TVs that are competitively priced for consumers. Roku TV brand partners also benefit from licensing the Roku OS because they do not have to develop or update their own operating system and we automatically update our OS on Roku TV models when there is an upgrade.

Under the Roku Powered program, we license the Roku OS and our streaming player designs, as well as provide ongoing technology and support services, to certain service operators that distribute Roku Powered players to their subscribers. The Roku Powered program has served as our entry point for certain international markets and has resulted in our brand becoming exposed to content publishers in these markets.

Sales and Marketing

We engage in a wide variety of sales and marketing activities to drive growth in both our platform and player segments and dedicate significant resources to this area. Our sales and marketing activities are primarily focused on building and expanding relationships with content publishers, advertisers, TV brands, retailers and service operators, and driving sales of our streaming players and audio products and Roku TV models to consumers through retail distribution channels.

We have dedicated business development teams that develop and maintain relationships, to promote and build awareness of the features and advantages of the Roku platform among content publishers, advertisers, TV brands and service operators. Our data science team supports our sales and marketing efforts by analyzing data on our platform to increase effectiveness for our content publishers and advertisers as well as for our consumer marketing campaigns. We enter into distribution agreements with our content publishers and license their content through our dedicated content relationship management team. Our relationship with content publishers is typically client-direct. We secure direct access to publishers' video ad inventory as part of our distribution agreements and serve as an additional channel for content publishers to monetize their audience. These sales efforts are differentiated and complementary to that of our content publishers. Whereas our publishers typically sell on a cross-platform basis and feature their brand and content in their sale, we focus on delivering a large OTT audience across many channels at once. We sell advertising to a wide range of advertisers helping them reach their goals across numerous key performance indicators. Our sales teams and products are organized into six groups that specialize in the unique needs of each area: (i) agency holding companies and Fortune 500 brands, (ii) independent agency and mid-market clients, (iii) content publishers and entertainment brands, (iv) performance and direct to consumer brands, (v) international markets and (vi) local advertising. We work with the major ad agencies and holding companies. We also offer smaller content publishers a self-serve platform to buy promotions and are increasingly incorporating programmatic capabilities into our advertising sales. Through our recent acquisition of dataxu, we also now provide marketers with a single, data-driven software solution to plan, buy and optimize their ad spend across TV and OTT advertising providers. Our expanded advertising capabilities include a TV-centric planning and buying toolset, automated bidding and a self-serve software solution to manage ad campaigns programmatically across multiple digital platforms.

We work with TV brands to assist in all phases of the development of Roku TV models, including development, planning, manufacturing and marketing. Similarly, we work with service operators on the planning and development of their Roku Powered players.

We, together with our Roku TV brand partners, offer consumers low cost, widely available streaming players and Roku TVs and we promote them using a wide range of marketing techniques. Roku players and Roku TVs are available at retail locations in the United States, Canada, the United Kingdom, France, the Republic of Ireland, Mexico, Brazil and several other Latin American countries. In the United States, the majority of streaming players, the Roku Smart Soundbar, Roku Wireless Subwoofer and Roku TV models are sold through traditional brick and mortar retailers, such as Best Buy, Target and Walmart, including their online sales platforms, and online retailers such as Amazon. We also sell our streaming players, Roku Smart Soundbar, Roku TV Wireless Speakers, Roku Wireless Subwoofer and other accessories in the United States directly through our website. In addition, in some cases, we sell our streaming players to service operators or channel partners who bundle such players with services that they sell to their customers. We also sell products internationally through distributors and to retailers. In the years ended December 31, 2019 and December 31, 2018, sales through Amazon, Best Buy and Walmart each accounted for more than 10% of our player segment revenue. These three retailers collectively accounted for 72% and 68% of our player segment revenue for the years ended December 31, 2019 and 2018, respectively. These retailers also sell products offered by our competitors. We support retailers with an experienced sales management team and work closely with these retailers to assist with in-store marketing and product mix forecasting.

Research and Development

Our research and development model relies on a combination of in-house staff and out-sourced design and manufacturing partners to cost-effectively improve and enhance our platform, and to develop new players, audio products, TVs, features and functionality. We work closely with content publishers, advertisers, TV brands and service operators to understand their current and future needs. We have designed a product development process that captures and integrates their feedback. In addition, we solicit user feedback in the development of new features and enhancements to the Roku platform.

We intend to continue to significantly invest in research and development to bring new devices to market and enhance our platform and capabilities.

Manufacturing

We outsource the manufacturing of our products to contract manufacturers, using our design specifications. All of our products are manufactured by contract manufacturers located in the People's Republic of China and South East Asia. Our contracts do not obligate them to supply products to us in any specific quantity or at any specific price. Our contract manufacturers procure components and assemble our products to demand forecasts we establish based upon historical trends and analysis from our sales and product management functions. The contract manufacturers ship our products to our third-party warehouses in California and England where they ship players directly to retailers, wholesale distributors and to end users.

Government Regulation

Our business and our devices and platform are subject to numerous domestic and foreign laws and regulations covering a wide variety of subject matters. These laws and regulations include general business regulations and laws, as well as regulations and laws specific to providers of Internet-delivered streaming services and Internet-connected devices. New laws and regulations in these areas may have an adverse effect on our business. The costs of compliance with these laws and regulations are high and are likely to increase in the future. If we fail to comply with these laws, we may be subject to significant liabilities and other penalties.

In particular, our business is subject to foreign and domestic laws and regulations applicable to companies conducting business using the Internet. Both domestic and foreign jurisdictions vary widely as to how, or whether, existing laws governing areas such as privacy and data security, online platform liability, consumer protection, payment processing or sales and other taxes and intellectual property apply to the Internet and e-commerce, and these laws are continually evolving. Moreover, the laws governing these areas, as well as those governing electronic contracts and Internet content and access restrictions, among other areas, are rapidly evolving. The laws in these areas are unsettled and future developments are unpredictable. Laws that lead to more stringent regulation of companies engaging in businesses using the Internet may have a negative impact on our business.

In the United States, the regulatory framework for privacy and security issues is rapidly evolving. State and federal consumer protection regulators generally exercise oversight of consumer privacy protections and the security of online services. California recently adopted the California Consumer Privacy Act of 2018 ("CCPA"), which gives California residents expanded rights to access and require deletion of their personal information, opt out of certain personal information sharing, and receive detailed information about how their personal information is used. The CCPA has prompted a number of proposals for new federal and state privacy legislation. State laws may also impose obligations on us in the event of a security breach or inadvertent disclosure of personal information. Foreign jurisdictions impose different, and sometimes more stringent, consumer and privacy protections, including the European Union ("EU") General Data Protection Regulation ("GDPR"). The GDPR broadly regulates the processing of personal information about individuals in the EU and includes significant penalties for non-compliance. Such consumer privacy laws are constantly changing and may become more diverse and restrictive over time, challenging our ability to fully comply with these laws in all jurisdictions. Privacy laws also may limit the ability of advertisers to fully utilize our platform, which could have a negative impact on our business.

Tax regulations in domestic and international jurisdictions where we do not currently collect state or local taxes may subject us to the obligation to collect and remit such taxes, to additional taxes or to requirements intended

to assist jurisdictions with their tax collection efforts. New legislation or regulation, the application of laws from jurisdictions whose laws do not currently apply to our business or the application of existing laws and regulations to the Internet and e-commerce generally could result in significant additional taxes on our business. An increasing number of jurisdictions are considering or have adopted laws or administrative practices that impose new tax measures, including revenue-based taxes, targeting online commerce and the remote selling of goods and services. These include new obligations to collect sales, consumption, value added, or other taxes on online marketplaces and remote sellers, or other requirements that may result in liability for third-party obligations. For example, certain countries, including member states of the EU have proposed or enacted taxes on online advertising and marketplace service revenues. Our results of operations and cash flows could be adversely affected by additional taxes of this nature imposed on us prospectively or retroactively or additional taxes or penalties resulting from the failure to comply with any collection obligations. The continued growth and demand for e-commerce is likely to result in more laws and regulations that impose additional compliance burdens on e-commerce companies, and any such developments could harm our business.

In addition, the Internet is a vital component of our business and also is subject to a variety of laws and regulations in jurisdictions throughout the world. We expect to rely on the historical openness and accessibility of the Internet to conduct our business, and government regulations that impede or fail to preserve the open Internet could harm our business. To the extent regulatory agencies adopt rules that allow network operators to restrict the flow of content over the Internet, such operators may seek to extract fees from us or our content publishers to deliver our traffic or may otherwise engage in blocking, throttling or other discriminatory practices with respect to our traffic, which could adversely impact our business.

Our content publishers also are subject to a wide range of government regulations that may vary by jurisdiction. Because our business depends on the availability of third-party content delivered over the Internet, increased regulation of our content publishers or changes in laws or regulations governing Internet retransmission of third-party content could increase our expenses and adversely affect our business and the attractiveness of our platform.

Intellectual Property

Our success depends in part upon our ability to protect our core technology and intellectual property. To establish and protect our proprietary rights, we rely on a combination of intellectual property rights, including patents, trademarks, copyrights, trade secret laws, license agreements, confidentiality procedures, employee disclosure and invention assignment agreements and other contractual rights.

As of December 31, 2019, we have over 100 issued patents and 200 pending applications in the United States and foreign countries. We also license technology from third parties when we believe it will facilitate our product offerings or business.

Competition

The TV streaming industry is highly competitive and, as it continues to evolve, we will continue to face aggressive competition in every aspect of our business. We compete with much larger companies which have resources and brand recognition that pose significant competitive challenges. In the face of this competition, we believe our success depends on our ability to acquire users by delivering high quality streaming devices at competitive prices, partnering with Roku TV brands to bring co-branded smart TVs to market, and developing and monetizing our streaming platform with compelling content, promotional services and advertising.

Our competitors include:

- traditional linear TV distribution and legacy pay TV services;
- companies that offer TV streaming devices that compete with our streaming players and Roku TV models and companies that license their operating systems for integration into smart TVs and other streaming products;

- TV brands that offer their own TV streaming solutions within their TVs and well as other devices like game consoles, DVD players, Blu-ray players and set-top boxes that leverage their own operating systems;
- mobile streaming platforms, that enable users to stream content on phones and tablets;
- companies that offer content and advertising mediums that are more attractive to advertisers than our streaming platform; and
- companies that operate in the same locations as our offices that may be better able attract and retain top talent in engineering, research and development, sales and marketing, operations and other organizations.

As the TV streaming market continues to develop, we may become subject to additional competition as we introduce or develop new products and services, as our existing products and services evolve, or as other companies introduce competing products and services.

Employees

As of December 31, 2019, we had approximately 1,650 full-time employees, of which approximately 850 were in research and development, approximately 550 were in sales and marketing, and approximately 250 were in general and administrative and operations. None of our employees are represented by a labor union with respect to his or her employment. We have not experienced any work stoppages and we consider our relations with our employees to be good.

Information about Segment and Geographic Areas

The segment and geographic information required herein is contained in Note 17 to the Consolidated Financial Statements in Item 8, which is incorporated herein by reference.

Corporate Information

We originally formed in October 2002 as Roku LLC under the laws of the State of Delaware. On February 1, 2008, Roku LLC was converted into Roku, Inc., a Delaware corporation. Roku, the Roku logo and other trade names, trademarks or service marks of Roku appearing in this report are the property of Roku. Trade names, trademarks and service marks of other companies appearing in this report are the property of their respective holders.

Available Information

We make available, free of charge through our website, our annual reports on Form 10-K, quarterly reports on Form 10-Q and current reports on Form 8-K, and amendments to those reports, filed or furnished pursuant to Sections 13(a) or Section 15(d) of the Securities Exchange Act of 1934, as amended, as soon as reasonably practicable after they have been electronically filed with, or furnished to, the Securities Exchange Commission ("SEC"). The SEC maintains an internet site (<http://www.sec.gov>) that contains reports, proxy and information statements, and other information regarding issuers that file electronically with the SEC. Our website address is www.roku.com. Information contained on or accessible through these websites is not incorporated by reference nor otherwise included in this report, and any references to these websites are intended to be inactive textual references only.

Item 1A. Risk Factors

Our business involves significant risks, some of which are described below. You should carefully consider the risks and uncertainties described below, together with all the other information in this Annual Report on Form 10-K, including “Management’s Discussion and Analysis of Financial Condition and Results of Operations” and the consolidated financial statements and the related notes. If any of the following risks actually occurs, our business, reputation, financial condition, results of operations, revenue, and future prospects could be seriously harmed. Unless otherwise indicated, references to our business being harmed in these risk factors will include harm to our business, reputation, financial condition, results of operations, revenue, and future prospects. In that event, the market price of our Class A common stock could decline, and you could lose part or all of your investment.

Risks Related to Our Business and Industry

We have incurred operating losses in the past, expect to incur operating losses in the future and may never achieve or maintain profitability.

We began operations in 2002 and we have experienced net losses in each year since inception. As of December 31, 2019, we had an accumulated deficit of \$313.8 million and for the year ended December 31, 2019, we had a net loss of \$59.9 million. We expect our operating expenses to increase in the future as we expand our operations. If our revenue and gross profit do not grow at a greater rate than our operating expenses, we will not be able to achieve and maintain profitability. We expect to incur significant losses in the future for a number of reasons, including without limitation the other risks and uncertainties described herein. Additionally, we may encounter unforeseen operating or legal expenses, difficulties, complications, delays and other factors that may result in losses in future periods. If our expenses exceed our revenue, we may never achieve or maintain profitability and our business may be harmed.

Our quarterly operating results may be volatile and are difficult to predict, and our stock price may decline if we fail to meet the expectations of securities analysts or investors.

Our revenue, gross profit and other operating results could vary significantly from quarter-to-quarter and year-to-year and may fail to match our past performance due to a variety of factors, including many factors that are outside of our control. Factors that may contribute to the variability of our operating results and cause the market price of our Class A common stock to fluctuate include:

- the entrance of new competitors or competitive products in our market, whether by established or new companies;
- our ability to retain and grow our active account base and increase engagement among new and existing users;
- our ability to maintain effective pricing practices, in response to the competitive markets in which we operate or other macroeconomic factors, such as inflation or increased taxes;
- our revenue mix, which drives gross profit;
- seasonal, cyclical or other shifts in revenue from advertising or player sales;
- the timing of the launch of new or updated products, channels or features;
- the addition or loss of popular content or channels;
- the ability of retailers to anticipate consumer demand;
- an increase in the manufacturing or component costs of our players or the manufacturing or component costs of our TV brand licensees for Roku TV models;
- delays in delivery of our players, or Roku TV models, or disruptions in our, or our licensees’ supply or distribution chains; and
- an increase in costs associated with protecting our intellectual property, defending against third-party intellectual property infringement allegations or procuring rights to third-party intellectual property.

Our gross margins vary across our devices and platform offerings. Player revenue has a lower gross margin compared to platform segment revenue derived through our arrangements with advertising, content distribution, billing and licensing activities. Gross margins on our players vary across player models and can change over time as a result of product transitions, pricing and configuration changes, component costs, player returns and other cost fluctuations. In addition, our gross margin and operating margin percentages, as well as overall profitability, may be

adversely impacted as a result of a shift in device, geographic or sales channel mix, component cost increases, price competition, or the introduction of new streaming devices, including those that have higher cost structures with flat or reduced pricing. We have in the past and may in the future strategically reduce our player gross margin in an effort to increase the number of active accounts and grow our gross profit. As a result, our player revenue may not increase as rapidly as it has historically, or at all, and, unless we are able to adequately increase our platform revenue and grow the number of active accounts, we may be unable to grow gross profit and our business will be harmed. If a reduction in gross margin does not result in an increase in our active accounts, increase our platform revenue and gross profit, our financial results may suffer, and our business may be harmed.

If we have difficulty managing our growth in operating expenses, our business could be harmed.

We have experienced significant growth in our research and development, sales and marketing, support services, operations and general and administrative functions in recent years and expect to continue to expand these activities. Our historical growth has placed, and expected future growth will continue to place, significant demands on our management, as well as our financial and operational resources, to:

- manage a larger organization;
- hire more employees, including engineers with relevant skills and experience;
- expand our manufacturing and distribution capacity;
- increase our sales and marketing efforts;
- broaden our customer support capabilities;
- support a larger number of TV brand and service operators;
- implement appropriate operational and financial systems;
- expand internationally; and
- maintain effective financial disclosure controls and procedures.

In addition, due to the continued growth in our headcount, we entered into lease agreements for a new corporate headquarters, which we began to occupy and started to incur material expenses for during 2019.

If we fail to manage our growth effectively, we may not be able to execute our business strategies and our business will be harmed.

TV streaming is highly competitive and many companies, including large technology companies, content owners and aggregators, TV brands and service operators, are actively focusing on this industry. If we fail to differentiate ourselves and compete successfully with these companies, it will be difficult for us to attract and retain users and our business will be harmed.

TV streaming is highly competitive and global. Our success depends in part on attracting and retaining users on, and effective monetization of, our streaming platform. To attract and retain users, we need to be able to respond efficiently to changes in consumer tastes and preferences and to offer our users access to the content they love on terms that they accept. Effective monetization requires us to continue to update the features and functionality of our streaming platform for users, content publishers and advertisers. We also must effectively support popular sources of streaming content, such as Amazon Prime Video, Apple TV+, Disney+, Hulu, Netflix and YouTube and respond rapidly to actual and anticipated market trends in the TV streaming industry.

Companies such as Amazon, Apple and Google offer TV streaming devices that compete with our streaming players and Roku TV. In addition, Google licenses its operating system software for integration into smart TVs and service provider set-top boxes and Amazon licenses its operating system software for integration into smart TVs. These companies have greater financial resources than we do and can subsidize the cost of their streaming devices in order to promote their other products and services, which could make it harder for us to acquire new users, retain existing users and increase streaming hours. These companies could also implement standards or technology that are not compatible with our products or that provide a better streaming experience. These companies also promote their brands through traditional forms of advertising, such as TV commercials, as well as digital advertising or website product placement, and have greater resources to devote to such efforts than we do.

In addition, many TV brands offer their own TV streaming solutions within their TVs. Other devices, such as game consoles and many DVD and Blu-ray players, also incorporate TV streaming functionality. Similarly, some service operators offer TV streaming applications as part of their cable service plans and can leverage their existing consumer bases, installation networks, broadband delivery networks and name recognition to gain traction in the TV streaming market. If consumers of TV streaming content prefer these alternative products to our streaming players and our partners' Roku TV models, we may not be able to achieve our expected growth in revenue, gross profit or ARPU.

In July 2018, we introduced our Roku TV Wireless Speakers, designed specifically for use with Roku TV models, and in September 2019, we launched our Roku Smart Soundbar and Roku Wireless Subwoofer. As a result of these developments, we may face additional competition from makers of TV audio speakers and soundbars, as well as makers of other TV peripheral devices. While our audio products have not generated significant revenue, if these products do not operate as designed or do not enhance the Roku TV or other viewing experience as we intend, our users' overall viewing experience may be diminished, and this may impact the overall demand for Roku TV models or our other products.

We expect competition in TV streaming from the large technology companies and service operators described above, as well as new and growing companies, to increase in the future. This increased competition could result in pricing pressure, lower revenue and gross profit or the failure of our players, Roku TV models and our platform to gain or maintain broad market acceptance. To remain competitive and maintain our position as a leading TV streaming platform we need to continuously invest in product development, marketing, service and support and device distribution infrastructure. In addition, evolving TV standards such as 4K, 8K, HDR and unknown future developments may require further investments in the development of our players, Roku TV and our platform. We may not have sufficient resources to continue to make the investments needed to maintain our competitive position. In addition, most of our competitors have longer operating histories, greater name recognition, larger customer bases and significantly greater financial, technical, sales, marketing and other resources than us, which provide them with advantages in developing, marketing or servicing new products and offerings. As a result, they may be able to respond more quickly to market demand, devote greater resources to the development, promotion and sales of their products or the distribution of their content, and influence market acceptance of their products better than we can. These competitors may also be able to adapt more quickly to new or emerging technologies or standards and may be able to deliver products and services at a lower cost. Increased competition could reduce our sales volume, revenue and operating margins, increase our operating costs, harm our competitive position and otherwise harm our business.

We also compete for video viewing hours with mobile platforms (phones and tablets), and users may prefer to view streaming content on such devices. Increased use of mobile or other platforms for TV streaming could adversely impact the growth of our streaming hours, harm our competitive position and otherwise harm our business.

We operate in an evolving industry, which makes it difficult to evaluate our business and prospects. If TV streaming develops more slowly than we expect, our operating results and growth prospects could be harmed. In addition, our future growth depends on the growth of digital advertising.

TV streaming is a rapidly evolving industry, making our business and prospects difficult to evaluate. The growth and profitability of this industry and the level of demand and market acceptance for our products and streaming platform are subject to a high degree of uncertainty. We believe that the continued growth of streaming as an entertainment alternative will depend on the availability and growth of cost-effective broadband internet access, the quality of broadband content delivery, the quality and reliability of new devices and technology, the cost for users relative to other sources of content, as well as the quality and breadth of content that is delivered across streaming platforms. These technologies, products and content offerings continue to emerge and evolve. In addition, many advertisers continue to devote a substantial portion of their advertising budgets to traditional advertising, such as linear TV, radio and print. The future growth of our business depends on the growth of digital advertising, and on advertisers increasing their spend on such advertising. We cannot be certain that they will do so. If advertisers do not perceive meaningful benefits of digital advertising, the market may develop more slowly than we expect, which could adversely impact our operating results and our ability to grow our business.

We may not be successful in our efforts to further monetize our streaming platform, which may harm our business.

Our business model depends on our ability to generate platform revenue from advertisers and content publishers. We generate platform segment revenue primarily from digital advertising and audience development campaigns that run across our streaming platform and from content distribution services. As such, we are seeking to expand our user base and increase the number of hours that are streamed across our platform in an effort to create additional platform revenue opportunities. As our user base grows and as we increase the amount of content offered and streamed across our streaming platform, we must effectively monetize our expanding user base and streaming activity. The total number of streaming hours, however, does not correlate with platform segment revenue on a period-by-period basis, primarily because we do not monetize every hour streamed on our streaming platform. Moreover, streaming hours on our platform are measured whenever a Roku player or a Roku TV is streaming content, whether a viewer is actively watching or not. For example, if a Roku player is connected to a TV, and the viewer turns off the TV, steps away or falls asleep and does not stop or pause the player then the particular streaming channel may continue to play content for a period of time determined by the streaming channel. We believe that this also occurs across a wide variety of non-Roku streaming devices and other set-top boxes. During the third quarter of 2019, we began rolling out a new Roku OS feature that is designed to identify when content has been continuously streaming on a channel for an extended period of time without user interaction. This feature periodically prompts the user to confirm that they are still watching the selected channel and closes the channel if the user does not respond affirmatively. We believe that implementing this new feature across the Roku platform will benefit us, our customers, channel partners and advertisers. Some of our leading channel partners, including Netflix, have already implemented similar features within their channels. This new Roku OS feature, which now has been rolled out to our entire installed base, supplements these channel features. While we expect continued robust growth in our aggregate streaming hours as we grow active accounts and user engagement with our streaming platform increases, we believe our year-over-year growth rates of streaming hours reported in 2020 are likely to be lower than the year-over-year growth rates we reported in 2019. We do not expect the rollout of this feature to have a material impact on our future financial performance.

Our ability to deliver more relevant advertisements to our users and to increase our platform's value to advertisers and content publishers depends on the collection of user engagement data, which may be restricted or prevented by a number of factors. Users may decide to opt out or restrict our ability to collect personal viewing data or to provide them with more relevant advertisements. Content publishers may also refuse to allow us to collect data regarding user engagement or refuse to implement mechanisms we request to ensure compliance with our legal obligations or technical requirements. For example, we are not able to fully utilize program level viewing data from many of our most popular channels to improve the relevancy of advertisements provided to our users. Other channels available on our platform, such as Amazon Prime Video, Apple TV+, Hulu and YouTube, are focused on increasing user engagement and time spent within their channel by allowing users to purchase additional content and streaming services within their channels. In addition, we do not currently monetize content provided on non-certified channels, which are not displayed in the Roku channel store and must be added manually by the user, on our streaming platform. If our users spend most of their time within particular channels where we have limited or no ability to place advertisements or leverage user information, or users opt out from our ability to collect data for use in providing more relevant advertisements, we may not be able to achieve our expected growth in platform segment revenue or gross profit. If we are unable to further monetize our streaming platform, our business may be harmed.

In order to materially increase the monetization of our streaming platform through the sale of digital advertising, we will need our users to stream significantly more ad-supported content. Our efforts to monetize our streaming platform through ad-supported content is still developing and may not continue to grow as we expect. Further, while we have experienced, and expect to continue to experience, growth in our revenue from advertising, our efforts to monetize our streaming platform through the distribution of AVOD content are still developing and our advertising revenue may not grow as we expect. This means of monetization will require us to continue to attract advertising dollars to our streaming platform as well as deliver AVOD content that appeals to users. Accordingly, there can be no assurance that we will be successful in monetizing our streaming platform through the distribution of ad-supported content.

We depend on a small number of content publishers for a majority of our streaming hours, and if we fail to maintain these relationships, our business could be harmed.

Historically, a small number of content publishers have accounted for a significant portion of the hours streamed on our platform. In the year ended December 31, 2019, the top three streaming services represented over 50% of all hours streamed in the period. If, for any reason, we cease distributing channels that have historically streamed a large percentage of the aggregate streaming hours on our platform, our streaming hours, active accounts or streaming device sales may be adversely affected, and our business may be harmed.

Most of our agreements with content publishers are not long term and can be terminated by the content publishers under certain circumstances. Any disruption in the renewal of such agreements may result in the removal of certain channels from our streaming platform and may harm our active account growth and engagement.

We enter into agreements with all our content publishers, which have varying terms and conditions, including expiration dates. Our agreements with content publishers generally have terms of one to three years and can be terminated before the end of the term by the content publisher under certain circumstances, such as if we materially breach the agreement, become insolvent, enter bankruptcy, commit fraud or fail to adhere to the content publishers' security or other platform certification requirements. Upon expiration of these agreements, we are required to re-negotiate and renew them in order to continue providing content from these content publishers on our streaming platform. We may not be able to reach a satisfactory agreement before our existing agreements have expired. If we are unable to renew such agreements on a timely basis on mutually agreeable terms, we may be required to temporarily or permanently remove certain channels from our streaming platform. The loss of such channels from our streaming platform for any period of time may harm our business. More broadly, if we fail to maintain our relationships with the content publishers on terms favorable to us, or at all, or if these content publishers face problems in delivering their content across our platform, we may lose channel partners or users and our business may be harmed.

If popular content is not available on our platform, we may fail to retain existing users and attract new users.

We must continuously maintain existing relationships and identify and establish new relationships with content publishers to provide popular content. In order to remain competitive, we must consistently meet user demand for popular streaming channels and content; particularly as we launch new players, new Roku TV models are introduced, or we enter new markets, including international markets. If we are not successful in helping our content publishers launch and maintain streaming channels that attract and retain a significant number of users on our streaming platform or if we are not able to do so in a cost-effective manner, our business will be harmed. Our ability to successfully help content publishers maintain and expand their channel offerings on a cost-effective basis largely depends on our ability to:

- effectively market new streaming channels and enhancements to our existing streaming channels;
- minimize launch delays of new and updated streaming channels; and
- minimize streaming platform downtime and other technical difficulties.

In addition, if service operators, including pay TV providers, refuse to grant our users access to stream certain channels or only make content available on devices they prefer, our ability to offer a broad selection of popular streaming channels or content may be limited.

If we fail to help our content publishers maintain and expand their channel offerings or their channels are not available, our business may be harmed.

Our growth will depend in part on our ability to develop relationships with TV brands and, to a lesser extent, service operators.

We developed, and intend to continue to develop, relationships with TV brands and, to a lesser extent, service operators in both the United States and international markets. Our licensing arrangements are complex and time-consuming to negotiate and complete. Our current and potential partners include TV brands, cable and satellite

companies and telecommunication providers. Under these license arrangements, we generally have limited control over the amount and timing of resources these entities dedicate to the relationship. If our TV brand or service operator partners fail to meet their forecasts for distributing licensed streaming devices, our business may be harmed.

We license the Roku OS and our smart TV hardware reference designs to certain TV brands to manufacture co-branded smart TVs. The primary economic benefits that we derive from these license arrangements have been and will likely continue to be indirect, primarily from growing our active accounts and increasing streaming hours on our platform. We have not received, nor do we expect to receive, significant license revenue from these arrangements in the near term, but we expect to incur expenses in connection with these commercial agreements. If these arrangements do not result in increased active accounts or streaming hours, our business may be harmed. The loss of a relationship with a TV brand or service operator could harm our results of operations, damage our reputation, increase pricing and promotional pressures from other partners and distribution channels, or increase our marketing costs. If we are not successful in maintaining existing and creating new relationships with any of these third parties, or if we encounter technological, content licensing or other impediments to our development of these relationships, our ability to grow our business could be adversely impacted.

We and our Roku TV brand partners depend on our retail sales channels to effectively market and sell our players and Roku TV models, and if we or our partners fail to maintain and expand effective retail sales channels, we could experience lower player or Roku TV sales.

To continue to increase our active accounts, we must maintain and expand our retail sales channels. The majority of our players and our TV brand partners' Roku TV models are sold through traditional brick and mortar retailers, such as Best Buy, Target and Walmart including their online sales platforms, and online retailers such as Amazon. To a lesser extent, we sell players directly through our website and internationally through distributors. For the year ended December 31, 2019, Amazon, Best Buy and Walmart in total accounted for 72% of our player segment revenue and are expected to each account for more than 10% of our player segment revenue in fiscal 2020. These three retailers collectively accounted for 68% and 61% of our player revenue for the years ended December 31, 2018 and 2017, respectively. These retailers and our international distributors also sell products offered by our competitors. We have no minimum purchase commitments or long-term contracts with any of these retailers or distributors. If one or several retailers or distributors were to discontinue selling our players or TV brands' Roku TV models or choose not to prominently display those devices in their stores or on their websites, the volume of our streaming devices sold could decrease, which would harm our business. For example, in April 2018, Amazon and Best Buy announced a partnership whereby two Best Buy controlled smart TV brands will exclusively utilize Amazon's operating system, and such TVs will be sold by Best Buy and Amazon. Although, to date, this arrangement has not limited our TV brand partners' ability to sell on either Amazon or at Best Buy, if our existing TV brands choose to work exclusively with other operating system developers, this may impact our ability to license the Roku OS and our smart TV hardware reference design to TV brands and our ability to continue to grow active accounts. Traditional retailers have limited shelf and end cap space in their stores and limited promotional budgets, and online retailers have limited prime website product placement space. Competition is intense for these resources, and a competitor with more extensive product lines and stronger brand identity, such as Amazon or Google, possesses greater bargaining power with retailers. In addition, one of our online retailers, Amazon, sells its own competitive streaming devices and is able to market and promote these products more prominently on its website, and could refuse to offer our devices. Any reduction in our ability to place and promote our devices, or increased competition for available shelf or website placement, would require us to increase our marketing expenditures simply to maintain our product visibility, which may harm our business. In particular, the availability of product placement during peak retail periods, such as the holiday season, is critical to our revenue growth, and if we are unable to effectively sell our devices during these periods, our business would be harmed.

We may be unable to successfully expand our international operations and our international expansion plans, if implemented, will subject us to a variety of risks that may harm our business.

We currently generate the vast majority of our revenue in the United States and have limited experience marketing, selling, licensing and supporting our devices and monetizing our streaming platform outside the United States. In addition, we have limited experience managing the administrative aspects of a global organization. While we intend to continue to explore opportunities to expand our business in international markets in which we see

compelling opportunities, we may not be able to create or maintain international market demand for our devices and streaming platform.

In the course of expanding our international operations and operating overseas, in addition to the risks we face in the United States, we will be subject to a variety of risks that could adversely affect our business, including:

- differing regulatory requirements, including country-specific data privacy and security laws and regulations, consumer protection laws and regulations, tax laws, trade laws, labor regulations, tariffs, export quotas, custom duties on cross-border movements of goods or data flows, or other trade restrictions;
- compliance with laws such as the Foreign Corrupt Practices Act, UK Bribery Act and other anti-corruption laws, export controls and economic sanctions, and local laws prohibiting corrupt payments to government officials;
- slower adoption and acceptance of streaming devices and services in other countries;
- competition with other devices that consumers may use to stream TV or existing local traditional pay TV services and products, including those provided by incumbent pay TV service providers;
- greater difficulty supporting and localizing our streaming devices and streaming platform, including delivering support and training documentation in languages other than English;
- our ability to deliver or provide access to popular streaming channels to users in certain international markets;
- different or unique competitive pressures as a result of, among other things, the presence of local consumer electronics companies and the greater availability of free content on over-the-air channels in certain countries;
- availability of reliable broadband connectivity and wide area networks in areas targeted for expansion;
- challenges inherent in efficiently staffing and managing an increased number of employees over large geographic distances, including the need to implement appropriate systems, policies, compensation and benefits, and compliance programs;
- difficulties in understanding and complying with local laws, regulations and customs in foreign jurisdictions;
- differing legal and court systems, including limited or unfavorable intellectual property protection;
- unstable political and economic conditions whatever the cause, including pandemics, Brexit, tariffs, trade wars, or long-term environmental risks;
- international political or social unrest or economic instability, including as a result of the United Kingdom's withdrawal from the EU, and other political tensions between countries in which we do business;
- adverse tax consequences such as those related to changes in tax laws or tax rates or their interpretations could impact our judgment in determining our tax provision and effective tax rate;
- the imposition of customs duties on cross-border data flows for streaming services, which are currently prohibited under the WTO's e-commerce moratorium, but could be permitted if certain WTO Members continue to oppose extension of the moratorium when it is considered at the WTO's MC-12 Ministerial Meeting in June 2020;
- digital services taxes, which have been imposed or are under consideration by several European and other countries, which would lead to taxes on certain digital services even though the providers would not be subject to tax under existing international tax rules and treaties;
- COVID-19 or any other pandemics or epidemics could result in decreased economic activity in certain markets, decreased use of our products, or in our decreased ability to import, export or sell our products to supply such services to existing or new customers in international markets;
- fluctuations in currency exchange rates could impact our revenue and expenses of our international operations and expose us to foreign currency exchange rate risk;
- restrictions on the repatriation of earnings from certain jurisdictions;
- future possible changes in U.S. regulations on exports of U.S. technologies or dealings with certain countries or parties; and
- working capital constraints.

If we invest substantial time and resources to expand our international operations and are unable to do so successfully and in a timely manner, our business and financial condition may be harmed.

If we are unable to maintain an adequate supply of quality video ad inventory on our platform or effectively sell our available video ad inventory, our business may be harmed.

While The Roku Channel serves as a valuable source of video ad inventory for us to sell, we are also dependent on our ability to monetize video ad inventory that we obtain from the publishers of ad-supported channels on our streaming platform. We may fail to attract content publishers that generate a sufficient quantity or quality of ad-supported content hours on our streaming platform and continue to grow supply of quality video ad inventory. Our business model depends on our ability to grow video ad inventory on our streaming platform and sell it to advertisers. Our access to video ad inventory in ad-supported streaming channels on our platform varies greatly among channels, accordingly, we do not have access to all of the video ad inventory on our platform. For certain channels, including YouTube's ad supported channel, we have no access to video ad inventory at this time, and we may not secure access in the future. The amount, quality and cost of video ad inventory available to us can change at any time. If we are unable to grow and maintain a sufficient supply of quality digital advertising inventory at reasonable costs to keep up with demand, our business may be harmed.

We operate in a highly competitive industry and we compete for revenue from advertising with other internet streaming platforms and services, as well as traditional media, such as radio, broadcast, cable and satellite TV, and satellite and internet radio. These competitors offer content and other advertising mediums that may be more attractive to advertisers than our streaming platform. These competitors are often very large and have more advertising experience and financial resources than we do, which may adversely affect our ability to compete for advertisers and may result in lower revenue and gross profit from advertising. If we are unable to increase our revenue from advertising by, among other things, continuing to improve our platform's capabilities to further optimize and measure advertisers' campaigns, increase our advertising inventory and expand our advertising sales team and programmatic capabilities, our business and our growth prospects may be harmed. We may not be able to compete effectively or adapt to any such changes or trends, which would harm our ability to grow our advertising revenue and harm our business.

Significant disruptions of our information technology systems or data security incidents could harm our reputation, cause us to modify our business practices and otherwise adversely affect our business and subject us to liability.

We are increasingly dependent on information technology systems and infrastructure to operate our business. In the ordinary course of our business, we collect, store, process and transmit large amounts of sensitive corporate, personal and other information, including intellectual property, proprietary business information, user payment card information, other user information and other confidential information. It is critical that we do so in a secure manner to maintain the confidentiality, integrity and availability of such information. Our obligations under applicable laws, contracts, industry standards, self-certifications, and other documentation may include maintaining the confidentiality, integrity and availability of personal information in our possession or control. These obligations create potential legal liability, to regulators, our business partners, our users, and other relevant stakeholders and also impact the attractiveness of our subscription service to existing and potential users.

We have outsourced certain elements of our operations (including elements of our information technology infrastructure) to third parties, or may have incorporated technology into our platform, that collects, processes, transmits and stores our users' or others' personal information (such as payment card information) and as a result, we manage a number of third-party vendors who may or could have access to our information technology systems (including our computer networks) or to our confidential information. In addition, many of those third parties in turn subcontract or outsource some of their responsibilities to third parties. As a result, our information technology systems, including the functions of third parties that are involved or have access to those systems, is very large and complex. While all information technology operations are inherently vulnerable to inadvertent or intentional security breaches, incidents, attacks and exposures, the size, complexity, accessibility and distributed nature of our information technology systems, and the large amounts of sensitive or personal information stored on those systems, make such systems potentially vulnerable to unintentional or malicious, internal and external threats on our technology environment. Vulnerabilities can be exploited from inadvertent or intentional actions of our employees, third-party vendors, business partners, or by malicious third parties. Attacks of this nature are increasing in their

frequency, levels of persistence, sophistication and intensity, and are being conducted by sophisticated and organized groups and individuals with a wide range of motives (including, but not limited to, industrial espionage) and expertise, including organized criminal groups, "hacktivists," nation states and others. For example, despite our efforts to secure our information technology systems and the data contained in those systems, including any efforts to educate or train our employees, we remain vulnerable to phishing attacks. In addition to the unauthorized access or acquisition of sensitive or personal information, such threats could include the deployment of harmful malware, ransomware, denial-of-service attacks, social engineering and other means to affect service reliability and threaten the confidentiality, integrity and availability of information. Some of these external threats may be amplified by the nature of our third-party web hosting, cloud computing, or network-dependent streaming services or suppliers. Our systems likely experience directed attacks on at least a periodic basis that are intended to interrupt our operations; interrupt our users', content publishers' and advertisers' ability to access our platform; extract money from us; and/or obtain our data (including without limitation user or employee personal information or proprietary information). Although we have implemented certain systems, processes, and safeguards intended to protect our information technology systems and data from such threats and mitigate risks to our systems and data, we cannot be certain that threat actors will not have a material impact on our systems or services in the future. Additionally, our third-party vendors or business partners' information technology systems may be vulnerable to similar threats and our business could be affected by those or similar third-party relationships.

We maintain insurance policies to cover certain losses relating to our information technology systems. However, there may be exceptions to our insurance coverage such that our insurance policies may not cover some or all aspects of a security incident. Even where an incident is covered by our insurance, the insurance limits may not cover the costs of complete remediation and redress that we may be faced with in the wake of a security incident. The successful assertion of one or more large claims against us that exceeds our available insurance coverage, or results in changes to our insurance policies (including premium increases or the imposition of large deductible or co-insurance requirements), could have an adverse effect on our business. In addition, we cannot be sure that our existing insurance coverage and coverage for errors and omissions will continue to be available on acceptable terms or that our insurers will not deny coverage as to any future claim. Though it is difficult to determine what harm may directly result from any specific interruption or breach, any failure to maintain performance, reliability, security and availability of our network infrastructure to the satisfaction of our users, business partners, regulators or other relevant stakeholders may harm our reputation and our ability to retain existing users and attract new users. Because of our prominence in the TV streaming industry, we believe we may be a particularly attractive target for threat actors. Our platform also incorporates licensed software from third-parties, including open source software, and we may also be vulnerable to attacks that focus on such third-party software. Any attempts by threat actors to disrupt our platform, our streaming devices, website, computer systems or our mobile apps, if successful, could harm our business, subject us to liability, be expensive to remedy, cause harm to our systems and operations and damage our reputation. Efforts to prevent threat actors from entering our computer systems or exploiting vulnerabilities in our devices are expensive to implement and may not be effective in detecting or preventing intrusion or vulnerabilities. Such unauthorized access to our data could damage our reputation and our business and could expose us to the risk of contractual damages, litigation and regulatory fines and penalties that could harm our business. The risk of harm to our business caused by security incidents may also increase as we expand our product and service offerings and as we enter into new markets. Implementing, maintaining, and updating security safeguards requires substantial resources now and will likely be an increasing and substantial cost in the future.

Significant disruptions of our third-party vendors' and/or commercial partners' information technology systems or other similar data security incidents could adversely affect our business operations and/or result in the loss, misappropriation, and/or unauthorized access, use or disclosure of, or the prevention of access to, sensitive or personal information, which could harm our business. In addition, information technology system disruptions, whether from attacks on our technology environment or from computer viruses, natural disasters, terrorism, war and telecommunication and electrical failures, could result in a material disruption of our product development and our business operations.

There is no way of knowing with certainty whether we have experienced any data security incidents that have not been discovered. While we have no reason to believe that we have experienced a data security incident that we have not discovered, attackers have become very sophisticated in the way they conceal their unauthorized access to systems, and many companies that have been attacked are not aware that they have been attacked. Any event that leads to unauthorized access, use or disclosure of personal information, including but not limited to personal

information regarding our users, could disrupt our business, harm our reputation, compel us to comply with applicable federal and/or state breach notification laws and foreign law equivalents, subject us to time consuming, distracting and expensive litigation, regulatory investigation and oversight, mandatory corrective action, require us to verify the correctness of database contents, or otherwise subject us to liability under laws, regulations and contractual obligations, including those that protect the privacy and security of personal information. This could result in increased costs to us and result in significant legal and financial exposure and/or reputational harm. For example, in the wake of a data breach involving payment card data, we may be subject to substantial penalties and related enforcement for failure to adhere to the technical or operational security requirements of the Payment Card Industry ("PCI") Data Security Standards ("DSS") imposed by the PCI Council to protect cardholder data. Penalties arising from PCI DSS enforcement are inherently uncertain as penalties may be imposed by various entities within the payment card processing chain without regard to any statutory or universally mandated framework. Such enforcement could threaten our relationship with our banks, card brands we do business with, and our third-party payment processors.

In addition, any failure or perceived failure by us or our vendors or business partners to comply with our privacy, confidentiality or data security-related legal or other obligations to third parties, or any further security incidents or other unauthorized access events that result in the unauthorized access, release or transfer of sensitive information, which could include personal information, may result in governmental investigations, enforcement actions, regulatory fines, litigation, or public statements against us by advocacy groups or others, and could cause third parties, including current and potential partners, to lose trust in us including existing or potential users' perceiving our platform, system or networks as less desirable or we could be subject to claims by third parties that we have breached our privacy- or confidentiality-related obligations, which could materially and adversely affect our business and prospects. There can be no assurance that the limitations of liability in our contracts would be enforceable or adequate or would otherwise protect us from liabilities or damages. Moreover, data security incidents and other inappropriate access can be difficult to detect, and any delay in identifying them may lead to increased harm of the type described above. While we have implemented security measures intended to protect our information technology systems and infrastructure, as well as the personal and proprietary information that we possess or control, there can be no assurance that such measures will successfully prevent service interruptions or further security incidents. Data protection laws around the world often take a principled, risk-based approach to information security and require "reasonable", "appropriate" or "adequate" technical and organizational security measures, meaning that the interpretation and application of those laws are often uncertain and evolving, and there can be no assurance that our security measures will be deemed adequate or reasonable in all instances. Moreover, even security measures that are deemed appropriate, reasonable, and/or in accordance with applicable legal requirements may not be able to protect the information we maintain. In addition to potential fines, we could be subject to mandatory corrective action due to a data security incident, which could adversely affect our business operations and result in substantial costs for years to come.

Our actual or perceived failure to adequately protect personal data and confidential information that we (or our service providers or business partners) collect, store or process could trigger contractual and legal obligations, harm our reputation, subject us to liability and otherwise adversely affect our business including our financial results.

In the ordinary course of our business, we collect, store and process personal data (including payment card information) and/or other confidential information of our employees, our partners, and our users. We use third-party service providers and subprocessors to help us deliver our services. These vendors may store or process personal information, payment card information and/or other confidential information of our employees, our partners, or our users. We collect such information from individuals located both in the United States and abroad and may store or process such information outside the country in which it was collected.

A variety of state, national, and foreign laws and regulations apply to the collection, use, retention, protection, disclosure, security, transfer and other processing of personal data. These privacy and data protection-related laws and regulations are evolving, with new or modified laws and regulations proposed and implemented frequently and existing laws and regulations subject to new or different interpretations. In addition, each state and the District of Columbia, Guam, Puerto Rico, the U.S. Virgin Islands, European Union member states, and the United Kingdom, as well as some other foreign nations, have passed laws requiring notification to regulatory authorities, to affected users, and/or others within a specific timeframe when there has been a security breach

involving certain personal data as well as impose additional obligations for companies. Additionally, our agreements with certain users or partners may require us to notify them in the event of a security breach. Such statutory and contractual disclosures are costly, could lead to negative publicity, may cause our customers to lose confidence in the effectiveness of our security measures and require us to expend significant capital and other resources to respond to and/or alleviate problems caused by the actual or perceived security breach. Compliance with these obligations could delay or impede the development of new products and may cause reputational harm.

Litigation resulting from security breaches may adversely affect our business. Unauthorized access to our platform, systems, networks, or physical facilities could result in litigation with our users, or other relevant stakeholders. These proceedings could force us to spend money in defense or settlement, divert management's time and attention, increase our costs of doing business, or adversely affect our reputation. We could be required to fundamentally change our business activities and practices or modify our products and/or platform capabilities in response to such litigation, which could have an adverse effect on our business. Any actual or perceived inability to adequately protect the privacy of individuals' information in our possession, custody or control may render our products or services less desirable and could harm our reputation and business. Any costs incurred as a result of this potential liability could harm our business.

We and our third-party contractors collect, process, transmit and store the personal information of our users, which creates legal obligations and exposes us to potential liability.

We collect, process, transmit and store information about a variety of individuals including our users and their devices, and rely on service providers to collect, process, transmit and store personal information of our users, including our users' payment card data. Further, we and our service providers as well as business partners use tracking technologies, including cookies, device identifiers and related technologies, to help us manage and track our users' interactions with our platform, devices, website and partners' content to deliver relevant advertising and personalized content for ourselves and on behalf of our partners on our devices.

We collect information about the interaction of users with our platform, devices, website, advertisements, and content publishers' streaming channels. To deliver relevant advertisements effectively, we must successfully leverage this data as well as data provided by third parties. Our ability to collect and use such data could be restricted by a number of factors, including users' having the ability to refuse consent to or opt out from our, our service providers or our advertising partners' collection and use of this data, restrictions imposed by advertisers, content publishers and service providers, changes in technology, and developments in laws, regulations and industry standards. For example, certain European Union laws and regulations prohibit access to or storage of information on a user's device (such as cookies and similar technologies that we use for advertising) that is not "strictly necessary" to provide a user-requested service or used for the "sole purpose" of a transmission unless the user has provided unambiguous, affirmative consent, and users may choose not to provide this consent to collection of information which is used for advertising purposes. Any restrictions on our ability to collect or use data could harm our ability to grow our revenue, particularly our platform revenue which depends on engaging the relevant recipients of advertising campaigns.

Various federal, state, and foreign laws and regulations as well as industry standards and contractual obligations govern the collection, use, retention, sharing and security of the data we receive from and about our users, employees and other individuals. The regulatory environment for the collection and use of personal data by device manufacturers, online service providers, content distributors, advertisers and publishers is evolving in the United States and internationally. Privacy groups and government bodies, including the Federal Trade Commission ("FTC"), state attorneys general, the European Commission and European data protection authorities, have increasingly scrutinized privacy issues with respect to devices that identify or are identifiable to a person and personal data collected through the internet, and we expect such scrutiny to continue to increase. The United States and foreign governments have enacted and are considering laws and regulations that could significantly restrict industry participants' ability to collect, use and share personal data, such as by regulating the level of consumer notice and consent required before a company can place cookies or other tracking technologies. For example, the EU General Data Protection Regulation ("GDPR") became effective in May 2018 and imposes detailed requirements related to the collection, storage and use of personal data related to people located in the EU or which is processed in the context of EU operations and places new data protection obligations and restrictions on organizations and may require us to make further changes to our policies and procedures in the future beyond what we have already done.

Further, in the wake of Brexit, there has been uncertainty with regard to the regulation of data protection in the United Kingdom. Although the United Kingdom enacted a Data Protection Act in May 2018, a level of uncertainty remains regarding how data transfers to and from the United Kingdom will be regulated after Brexit. We made changes to our data protection compliance program to prepare for the GDPR and will continue to monitor the implementation and evolution of data protection regulations, but if we are not compliant with GDPR or other data protection laws or regulations if and when implemented, we may be subject to significant fines and penalties (such as restrictions on personal data processing) and our business may be harmed. For example, under the GDPR, fines of up to EUR 20 million or 4% of the annual global revenue of a noncompliant company, whichever is greater, as well as data processing restrictions could be imposed for violation of certain of the GDPR's requirements. Other countries have also proposed or passed legislation with personal data obligations similar to that of the GDPR.

The U.S. data protection legal landscape also continues to evolve, with California and Nevada having enacted broad-based data privacy and protection legislation and with states and the federal government continuing to consider additional data privacy and protection legislation. The potential effects of this legislation are far-reaching and may require us to modify our data processing practices and policies and to incur substantial costs and expenses in an effort to comply. Effective October 1, 2019, Nevada amended its existing Security of Personal Information Law ("SPI Law") to now require, among other things, that certain businesses provide a designated request address to intake requests from consumers to opt out of the sale of their personal data. The California Consumer Privacy Act ("CCPA") went into effect in January 2020 and gives California residents certain rights with respect to their personal information such as rights to access and require deletion of their personal information, opt out of the sale of their personal information, and receive detailed information about how their personal information is used. The CCPA also provides for civil penalties for violations, as well as a private right of action for data breaches that may increase data breach litigation. The CCPA was amended and the California Office of the Attorney General has proposed regulations to implement portions of the CCPA. These regulations are subject to public comment. Depending on the final text of the regulations, they may significantly impact the CCPA compliance measures we have, or will, undertake.

We are continuing to assess the impact of new and proposed data privacy and protection laws and proposed amendments to existing laws on our business.

Applicable data privacy and security laws may also obligate us to employ security measures that are appropriate to the nature of the data we collect and process and, among other factors, the risks attendant to our data processing activities in order to protect personal information from unauthorized access or disclosure, or accidental or unlawful destruction, loss, or alteration. We have implemented security measures that we believe are appropriate, but a regulator could deem our security measures not to be appropriate given the lack of prescriptive measures in certain data protection laws. Given the evolving nature of security threats and evolving safeguards, we cannot be sure that our chosen safeguards will protect against security threats to our business including the personal data that we process. However, even security measures that are appropriate, reasonable, and/or in accordance with applicable legal requirements may not be able to fully protect our information technology systems and the data contained in those systems, or our data that is contained in third parties' systems. Moreover, certain data protection laws impose on us responsibility for our employees and third parties that assist with aspects of our data processing. Our employees' or third parties' intentional, unintentional, or inadvertent actions may increase our vulnerability or expose us to security threats, such as phishing attacks, and we may remain responsible for successful access, acquisition or other disclosure of our data despite the quality and legal sufficiency of our security measures.

As part of our data protection compliance program, we have implemented data transfer mechanisms to provide for the transfer of personal data from the European Economic Area (the "EEA") to the United States. However, there are certain unsettled legal issues regarding the adequacy of these data transfer mechanisms, the resolution of which may adversely affect our ability to transfer personal data from the EEA to the United States. We will continue to review our business practices and may find it necessary or desirable to make changes to our personal data processing to cause our transfer and receipt of EEA residents' personal data to conform to applicable European law. The regulation of data privacy in the EU continues to evolve, and it is not possible to predict the ultimate effect of evolving data protection regulation and implementation over time. Member states also have some flexibility to supplement the GDPR with their own laws and regulations and may apply stricter requirements for certain data processing activities.

In addition, some countries are considering or have enacted 'data localization' laws requiring that user data regarding users in their country be maintained in their country. Maintaining local data centers in individual countries could increase our operating costs significantly. We expect that, in addition to the business as usual costs of compliance, the evolving regulatory interpretation and enforcement of laws such as the GDPR and CCPA and other domestic and foreign data protection laws will lead to increased operational and compliance costs and will require us to continually monitor and, where necessary, make changes to our operations, policies, and procedures. Any failure or perceived failure to comply with privacy-related legal obligations, or any compromise of security of user data, may result in governmental enforcement actions, litigation, contractual indemnity or public statements against us by consumer advocacy groups or others. In addition to potential liability, these events could harm our business.

We publish privacy policies, notices, self-certifications (such as the EU-US Privacy Shield), and other documentation regarding our collection, processing, use and disclosure of personal information, credit card information and/or other confidential information. Although we endeavor to comply with our published policies, certifications, and documentation, we may at times fail to do so or may be perceived to have failed to do so. Moreover, despite our efforts, we may not be successful in achieving compliance if our employees or vendors fail to comply with our published policies, certifications, and documentation. Such failures can subject us to potential international, local, state and federal action if they are found to be deceptive, unfair, or misrepresentative of our actual practices.

We have incurred, and will continue to incur, expenses to comply with privacy and security standards and protocols imposed by law, regulation, industry standards and contractual obligations. Increased regulation of data collection, use and security practices, including self-regulation and industry standards, changes in existing laws, enactment of new laws, increased enforcement activity, and changes in interpretation of laws, could increase our cost of compliance and operation, limit our ability to grow our business or otherwise harm our business.

If government regulations or laws relating to the internet, video, advertising, or other areas of our business change, we may need to alter the manner in which we conduct our business, or our business could be harmed.

We are subject to general business regulations and laws, as well as regulations and laws specific to the internet and online services, which may include laws and regulations related to data privacy and security, consumer protection, data localization, law enforcement access to data, encryption, telecommunications, social media, payment processing, taxation, intellectual property, competition, electronic contracts, internet access, net neutrality, advertising, calling and texting, content restrictions, and accessibility, among others. We cannot guarantee that we have been or will be fully compliant in every jurisdiction. Litigation and regulatory proceedings are inherently uncertain, and the laws and regulations governing issues such as data privacy and security, payment processing, taxation, net neutrality, video, telecommunications, e-commerce tariffs and consumer protection related to the internet continue to develop. For example, laws relating to the liability of providers of online services for activities of their users and other third parties have been tested by a number of claims, including actions based on invasion of privacy and other torts, unfair competition, copyright and trademark infringement, and other theories based on the nature and content of the materials searched, the advertisements posted, actions taken or not taken by providers in response to user activity or the content provided by users. Congress has also enacted legislation related to liability of providers of online services and may continue to legislate in this area. The CCPA and Nevada SPI Law also apply to entities that do business in California and Nevada, respectively, and impose a number of requirements on internet and online services. Moreover, as internet commerce and advertising continue to evolve, increasing regulation by federal, state and foreign regulatory authorities becomes more likely.

As we develop new services and devices, and improve our streaming platform, we may also be subject to new laws and regulations specific to such technologies. For example, in developing our Roku TV reference design, we were required to understand, address and comply with an evolving regulatory framework for developing, manufacturing, marketing and selling TVs. If we fail to adequately address or comply with such regulations regarding the manufacture and sale of TVs, we may be subject to fines or sanctions, and our licensees may be unable to sell Roku TV models at all, which would harm our business and our ability to grow our user base.

Laws relating to data privacy and security, data localization, law enforcement access to data, encryption, and similar activities continue to proliferate, often with little harmonization between jurisdictions and limited

guidance. A number of existing bills are pending in the U.S. Congress and other government bodies that contain provisions that would regulate, for example, how companies can use cookies and other tracking technologies to collect, use and share user information. The CCPA also imposes requirements on certain tracking activity, and we are continuing to assess the impact of the CCPA and proposed amendments to the law on our business. The EU already has existing laws, which are due for update in 2020, requiring advertisers or companies like ours to, for example, obtain unambiguous, affirmative consent from users for the placement of cookies or other tracking technologies and the delivery of relevant advertisements. If we or the third parties that we work with, such as contract payment processing services, content publishers, vendors or developers violate or are alleged to violate applicable privacy or security laws, industry standards, our contractual obligations, or our policies, such violations and alleged violations may also put our users' information at risk and could in turn harm our business and reputation and subject us to potential liability. Any of these consequences could cause our users, advertisers or publishers to lose trust in us, which could harm our business. Furthermore, any failure on our part to comply with these laws may subject us to liability and reputational harm.

Our use of data to deliver relevant advertising and other services on our platform places us and our content publishers at risk for claims under various unsettled laws, including the Video Privacy Protection Act ("VPPA"). Some of our content publishers have been engaged in litigation over alleged violations of the VPPA relating to activities on our platform in connection with advertising provided by unrelated third parties. The Federal Trade Commission has also in recent years revised its rules implementing the Children's Online Privacy Protection Act ("COPPA Rules") broadening the applicability of the COPPA Rules, including the types of information that are subject to these regulations, and it is currently examining whether additional changes are appropriate. Such actions could limit the information that we or our content publishers and advertisers may collect and use through certain content publishers, the content of advertisements and in relation to certain channel partner content. The CCPA also imposes certain opt in and opt out requirements for certain information about minors. We and our content publishers and advertisers could be at risk for violation or alleged violation of these and other privacy, advertising, or similar laws.

Any significant disruption in our computer systems or those of third parties we utilize in our operations could result in a loss or degradation of service on our platform and could harm our business.

We rely on the expertise of our engineering and software development teams for the performance and operation of the Roku OS, streaming platform and computer systems. Service interruptions, errors in our software or the unavailability of computer systems used in our operations could diminish the overall attractiveness of our devices and streaming platform to existing and potential users. We utilize computer systems located either in our facilities or those of third-party server hosting providers and third-party internet-based or cloud computing services. Although we generally enter into service level agreements with these parties, we exercise no control over their operations, which makes us vulnerable to any errors, interruptions or delays that they may experience. In the future, we may transition additional features of our services from our managed hosting systems to cloud computing services, which may require significant expenditures and engineering resources. If we are unable to manage a transition effectively, we may experience operational delays and inefficiencies until the transition is complete. Upon the expiration or termination of any of our agreements with third-party vendors, we may not be able to replace their services in a timely manner or on terms and conditions, including service levels and cost, that are favorable to us, and a transition from one vendor to another vendor could subject us to operational delays and inefficiencies until the transition is complete. In addition, fires, floods, earthquakes, power losses, telecommunications failures, break-ins and similar events could damage these systems and hardware or cause them to fail completely. As we do not maintain entirely redundant systems, a disrupting event could result in prolonged downtime of our operations and could adversely affect our business. Any disruption in the services provided by these vendors could have adverse impacts on our business reputation, customer relations and operating results.

If any aspect of our computer systems or those of third parties we utilize in our operations fails, it may lead to downtime or slow processing time, either of which may harm the experience of users. We have experienced, and may in the future experience, service disruptions, outages and other performance problems due to a variety of factors, including infrastructure changes, human or software errors and capacity constraints. We expect to continue to invest in our technology infrastructure to maintain and improve the user experience and platform performance. To the extent that we or our third-party service hosting provider do not effectively address capacity constraints, upgrade or patch systems as needed and continually develop technology and network architecture to accommodate

increasingly complex services and functions, increasing numbers of users, and actual and anticipated changes in technology, our business may be harmed.

Our players and Roku TV models must operate with various offerings, technologies and systems from our content publishers that we do not control. If our streaming devices do not operate effectively with those offerings, technologies and systems, our business may be harmed.

The Roku OS is designed for performance using relatively low-cost hardware, which enables us to drive user growth with our players and Roku TV models offered at a low cost to consumers. However, this hardware must be interoperable with all channels and other offerings, technologies and systems from our content publishers, including virtual multi-channel video programming distributors. We have no control over these offerings, technologies and systems beyond our channel certification requirements, and if our players and Roku TV models do not provide our users with a high-quality experience on those offerings on a cost-effective basis or if changes are made to those offerings that are not compatible with our players or Roku TV models, we may be unable to increase active account growth and user engagement, we may be required to increase our hardware costs and our business will be harmed. We plan to continue to introduce new products regularly and we have experienced that it takes time to optimize such products to function well with these offerings, technologies and systems. In addition, many of our largest content publishers have the right to test and certify our new products before we can publish their channels on these devices. The certification processes can be time consuming and introduce third-party dependencies into our product release cycles. If content publishers do not certify new products on a timely basis or require us to make changes in order to obtain certifications, our product release plans may be adversely impacted, or we may not continue to offer certain channels. To continue to grow our active accounts and user engagement, we will need to prioritize development of our streaming devices to work better with new offerings, technologies and systems. If we are unable to maintain consistent operability of our devices that is on parity with or better than other platforms, our business could be harmed. In addition, any future changes to offerings, technologies and systems from our content publishers, such as virtual service operators, may impact the accessibility, speed, functionality, and other performance aspects of our streaming devices. We may not successfully develop streaming devices that operate effectively with these offerings, technologies or systems. If it becomes more difficult for our users to access and use these offerings, technologies or systems, our business could be harmed.

If our content publishers do not continue to develop channels for our platform and participate in new features that we may introduce from time to time, our business may be harmed.

As our streaming platform and products evolve, we will continue to introduce new features, which may or may not be attractive to our content publishers or meet their requirements. For example, some content publishers have elected not to participate in our cross-channel search feature, our integrated advertising framework, or have imposed limits on our data gathering for usage within their channels. In addition, our streaming platform utilizes our proprietary Brightscript scripting language in order to allow our content publishers to develop and create channels on our streaming platform. If we introduce new features or utilize a new scripting language in the future, such a change may not comply with our content publishers' certification requirements. In addition, our content publishers may find other languages, such as HTML5, more attractive to develop for and shift their resources to developing their channels on other platforms. If content publishers do not find our streaming platform simple and attractive to develop channels for, do not value and participate in all of the features and functionality that our streaming platform offers, or determine that our software developer kit or new features of our platform do not meet their certification requirements, our business may be harmed.

If the advertising and audience development campaigns on our platform are not relevant or not engaging to our users, our growth in active accounts and streaming hours may be adversely impacted.

We have made, and are continuing to make, investments to enable advertisers and content publishers to deliver relevant advertisements and audience development campaigns to our users. Existing and prospective advertisers and content publishers may not be successful in serving ads and audience development campaigns that lead to and maintain user engagement. Those ads and campaigns may seem irrelevant, repetitive or overly targeted and intrusive. We are continuously seeking to balance the objectives of our content publishers and advertisers with our desire to provide an optimal user experience, but we may not be successful in achieving a balance that continues to attract and retain users, content publishers and advertisers. If we do not introduce relevant advertisements and

audience development campaigns or such advertisements and audience development campaigns are overly intrusive and impede the use of our streaming platform, our users may stop using our platform which will harm our business.

The Roku Channel may not continue to attract a large number of users and/or generate significant revenue from advertising, and our users may not purchase Premium Subscriptions.

We operate The Roku Channel, which offers both ad-supported free access for users to a collection of films, television series and other content as well as Premium Subscriptions, which we launched in January 2019, allowing our users to pay for ad-free content from various content publishers, all on one streaming channel. We have incurred, and will continue to incur, costs and expenses in connection with the development, expansion and operation of The Roku Channel, which we monetize primarily through advertising. If our users do not continue to stream the free, ad-supported content we make available on The Roku Channel, we will not have the opportunity to monetize The Roku Channel through revenue generated from advertising. In order to attract users to the ad-supported content on The Roku Channel and drive streaming of ad-supported video on The Roku Channel, we must secure rights to stream content that is appealing to our users and advertisers. In part, we do this by directly licensing certain content from content owners, such as television and movie studios. The agreements that we enter into with these content owners have varying terms and provide us with rights to make specific content available through The Roku Channel during certain periods of time. Upon expiration of these agreements, we are required to re-negotiate and renew these agreements with the content owners, or enter into new agreements with other content owners, in order to obtain rights to distribute additional titles or to extend the duration of the rights previously granted. If we are unable to enter into content license agreements on acceptable terms to access content that enables us to attract and retain users of the ad-supported content on The Roku Channel, usage of The Roku Channel may decline, and our business may be harmed. Furthermore, if the advertisements on The Roku Channel are not relevant to our users or such advertisements are overly intrusive and impede our users' enjoyment of the available content, our users may not stream content and view advertisements on The Roku Channel, and The Roku Channel may not generate sufficient revenue from advertising to be cost effective for us to operate, regardless of our ability to sell Premium Subscriptions. In addition, we distribute The Roku Channel on platforms other than our own streaming platform, and there can be no assurance that we will be successful in attracting a large number of users and/or generating significant revenue from advertising through the distribution of The Roku Channel on such other streaming platforms.

If our users sign up for offerings and services outside of our platform or through other channels on our platform, our business may be harmed.

We earn revenue by acquiring subscribers for certain of our content publishers activated on or through our platform. If users do not use our platform for these purchases or subscriptions for any reason, and instead pay for services directly with content publishers or by other means that we do not receive attribution for, our business may be harmed. In addition, certain channels available on our platform allow users to purchase additional streaming services from within their channels. The revenue we earn from these transactions are generally not equivalent to the revenue we earn from activations on or through our platform that we receive full attribution credit for. Furthermore, for Premium Subscriptions, we only earn revenue for SVOD channels, including subscriptions to these services through The Roku Channel. Accordingly, if users activate subscriptions for SVOD channels, including channels available as Premium Subscriptions through The Roku Channel other than on our platform, our business may be harmed.

Our revenue and gross profit are subject to seasonality and if our sales during the holiday season fall below our expectations, our business may be harmed.

Seasonal consumer shopping patterns significantly affect our business. Specifically, our revenue and gross profit are traditionally strongest in the fourth quarter of each fiscal year and represent a high percentage of the total net revenue for such fiscal year due to higher consumer purchases and increased advertising during holiday periods. Furthermore, a significant percentage of our player sales through retailers in the fourth quarter are pursuant to committed sales agreements with retailers for which we recognize significant discounts in the average selling prices in the third quarter in an effort to grow our active accounts, which will reduce our player gross margin.

Given the seasonal nature of our player sales, accurate forecasting is critical to our operations. We anticipate that this seasonal impact on revenue and gross profit is likely to continue, and any shortfall in expected

fourth quarter revenue due to macroeconomic conditions, a decline in the effectiveness of our promotional activities, actions by our competitors or disruptions in our supply or distribution chain, tariffs or other restrictions on trade or for any other reason, would cause our full year results of operations to suffer significantly. For example, delays or disruptions at U.S. ports of entry could adversely affect our or our distributors' ability to timely deliver players and co-branded Roku TV models to retailers during the holiday season. A substantial portion of our expenses are personnel related and include salaries, stock-based compensation and benefits that are not seasonal in nature. Accordingly, in the event of a revenue shortfall, we would be unable to mitigate the negative impact on gross profit and operating margins, at least in the short term, and our business would be harmed.

Changes in consumer viewing habits could harm our business.

The manner in which consumers access streaming content is changing rapidly. As the technological infrastructure for internet access continues to improve and evolve, consumers will be presented with more opportunities to access video, music and games on-demand with interactive capabilities. Time spent on mobile devices is growing rapidly, in particular by young adults streaming content as well as content from cable or satellite providers available live or on-demand on mobile devices. In addition, personal computers, smart TVs, DVD players, Blu-ray players, gaming consoles and cable set-top boxes allow users to access streaming content. If other streaming or technology providers are able to respond and take advantage of changes in consumer viewing habits and technologies better than us, our business could be harmed.

New entrants may enter the TV streaming market with unique service offerings or approaches to providing video. In addition, our competitors may enter into business combinations or alliances that strengthen their competitive positions. If new technologies render the TV streaming market obsolete or we are unable to successfully compete with current and new competitors and technologies, our business will be harmed.

If our efforts to build a strong brand and maintain customer satisfaction and loyalty are not successful, we may not be able to attract or retain users, and our business may be harmed.

Building and maintaining a strong brand is important to attract and retain users, as potential users have a number of TV streaming choices. Successfully building a brand is a time consuming and comprehensive endeavor and can be positively and negatively impacted by any number of factors. Certain factors, such as the quality or pricing of our players or our customer service, are within our control. Other factors, such as the quality and reliability of Roku TV models and the quality of the content that our content publishers provide, may be out of our control, yet users may nonetheless attribute those factors to us. Our competitors may be able to achieve and maintain brand awareness and market share more quickly and effectively than we can. Many of our competitors are larger companies and promote their brands through traditional forms of advertising, such as print media and TV commercials, and have substantial resources to devote to such efforts. Our competitors may also have greater resources to utilize digital advertising or website product placement more effectively than we can. If we are unable to execute on building a strong brand, it may be difficult to differentiate our business and streaming platform from our competitors in the marketplace, therefore our ability to attract and retain users may be adversely affected and our business may be harmed.

Our streaming platform allows our users to choose from thousands of channels, representing a variety of content from a wide range of content publishers. Our users can choose and control which channels they download and watch, and they can use certain settings to prevent channels from being downloaded to our streaming devices. While we have policies that prohibit the publication of content that is unlawful, incites illegal activities or violates third-party rights, among other things, we may distribute channels that include controversial content. Controversies related to the content included on certain of the channels that we distribute could result in negative publicity, cause harm to our reputation and brand or subject us to claims and may harm our business.

We must successfully manage streaming device and other product introductions and transitions to remain competitive.

We must continually develop new and improved streaming devices and other products that meet changing consumer demands. Moreover, the introduction of a new streaming device or other product is a complex task, involving significant expenditures in research and development, promotion and sales channel development. For example, in 2018, we introduced our Roku TV Wireless Speakers, designed specifically for use with Roku TV

models, and in 2019 we introduced our Roku Smart Soundbar and Roku Wireless Subwoofer. Whether users will broadly adopt new streaming devices or other products is not certain. Our future success will depend on our ability to develop new and competitively priced streaming devices and other products and add new desirable content and features to our streaming platform. Moreover, we must introduce new streaming devices and other products in a timely and cost-effective manner, and we must secure production orders for those products from our contract manufacturers. The development of new streaming devices and other products is a highly complex process, and while our research and development efforts are aimed at solving increasingly complex problems, we do not expect that all of our projects will be successful. The successful development and introduction of new streaming devices and products depends on a number of factors, including:

- the accuracy of our forecasts for market requirements beyond near term visibility;
- our ability to anticipate and react to new technologies and evolving consumer trends;
- our development, licensing or acquisition of new technologies;
- our timely completion of new designs and development;
- the ability of our contract manufacturers to cost-effectively manufacture our new products;
- the availability of materials and key components used in manufacturing;
- tariffs which could impact the pricing of such devices and depress consumer demand; and
- our ability to attract and retain world-class research and development personnel.

If any of these or other factors materializes, we may not be able to develop and introduce new products in a timely or cost-effective manner, and our business may be harmed.

We do not have manufacturing capabilities and primarily depend upon a small number of contract manufacturers, and our operations could be disrupted if we encounter problems with our contract manufacturers.

We do not have any internal manufacturing capabilities and primarily rely upon one contract manufacturer to build our players, smart soundbars and wireless subwoofers. We similarly rely on another contract manufacturer to manufacture our wireless speakers. Our contract manufacturers are vulnerable to:

- capacity constraints,
- reduced component availability,
- production disruptions or delays, including from strikes, mechanical issues, quality control issues, natural disasters, and public health crises, such as the outbreak of the coronavirus, known as COVID-19; and
- the impact of U.S. or foreign tariffs on components or finished goods;
- increases in U.S. tariffs on imports of our players; and
- foreign tariffs on U.S. parts or components for finished players that are assembled in Asia.

As a result, we have limited control over delivery schedules, manufacturing yields and costs, particularly when components are in short supply or when we introduce new streaming devices or other products.

We also have limited control over our contract manufacturers' quality systems and controls, and therefore must rely on them to manufacture our players and other products to our quality and performance standards and specifications. Delays, component shortages and other manufacturing and supply problems could impair the retail distribution of our players and other products and ultimately our brand. Furthermore, any adverse change in our contract manufacturers' financial or business condition could disrupt our ability to supply our players or other products to our retailers and distributors.

Our contracts with our contract manufacturers generally do not obligate them to supply our players or other products in any specific quantity or at any specific price. In the event our contract manufacturers are unable to fulfill our production requirements in a timely manner, their costs increase because of U.S. or international tariffs, or they decide to terminate their relationship with us, our order fulfillment may be delayed, and we would have to identify, select and qualify acceptable alternative contract manufacturers. Alternative contract manufacturers may not be available to us when needed or may not be in a position to satisfy our production requirements at commercially reasonable prices, to our quality and performance standards or at all. Any significant interruption in manufacturing

at one of our contract manufacturers for any reason could require us to reduce our supply of players or other products to our retailers and distributors, which in turn would reduce our revenue. In addition, our contract manufacturers' facilities are located in South East Asia and the People's Republic of China and may be subject to political, economic, labor, trade, social and legal uncertainties that may harm our relationships with these parties. We believe that the international location of these facilities increases supply risk, including the risk of supply interruptions, tariffs, trade and export or import restrictions. Furthermore, any manufacturing issues affecting the quality of our products, including players and audio products, could harm our business.

If either of our contract manufacturers fails for any reason to continue manufacturing our players or other products in required volumes and at high quality levels, or at all, we would have to identify, select and qualify an acceptable alternative contract manufacturer or manufacturers. Alternative contract manufacturers may not be available to us when needed, or at all, or may not be in a position to satisfy our production requirements at commercially reasonable prices, to our quality and performance standards, or at all. Any significant interruption in manufacturing at a contract manufacturer could require us to reduce our supply of players or other products to our retailers and distributors, which in turn would reduce our revenue, active account growth or streaming hour growth.

Certain Roku TV brands do not have manufacturing capabilities and primarily depend upon contract manufacturers, and the supply of Roku TV models to the market could be disrupted if they encounter problems with their contract manufacturers or suppliers.

Certain Roku TV brands do not have internal manufacturing capabilities and primarily rely upon contract manufacturers to build the Roku TV models that they sell to retailers. Their contract manufacturers may be vulnerable to capacity constraints and reduced component availability, increases in U.S. tariffs on imports of Roku TV models, future possible changes in U.S. regulations on exports of U.S. technologies or dealings with certain countries or parties, international tariffs on U.S. parts or components for Roku TV models that are assembled outside of the U.S., and their control over delivery schedules, manufacturing yields and costs, particularly when components are in short supply may be limited. Delays, component shortages and other manufacturing and supply problems could impair the retail distribution of their Roku TV models. A significant interruption in the supply of Roku TV models to retailers and distributors could, in turn, reduce our active accounts and streaming hours.

Furthermore, any manufacturing issues affecting the quality of our Roku TV brand partners' Roku TV models, could harm our brand and our business.

Changes in general economic conditions, geopolitical conditions, U.S. trade policies and other factors beyond our control may adversely impact our business and operating results.

Our business is subject to risks generally associated with doing business abroad, such as U.S. and foreign governmental regulation in the countries in which our contract manufacturers and component suppliers are located. Our operations and performance depend significantly on global, regional and U.S. economic and geopolitical conditions. For example, there has been discussion and dialogue regarding potential significant changes to U.S. trade policies, legislation, treaties and tariffs. For example, in November 2018 the United States, Mexico, and Canada signed the United States-Mexico-Canada Agreement ("USMCA") which supersedes the North American Free Trade Agreement. The USMCA still must be ratified by the respective governments of each of the three countries. Congress approved the USMCA in the United States-Mexico-Canada Agreement Implementation Act (H.R.5430) in January 2020 (the "Act"), and the Act was signed into law in January 2020. While the Act authorizes the President to declare that the USMCA agreement has entered into force, under U.S. practice, the Office of the U.S. Trade Representative must review Mexico's and Canada's laws and regulations to ensure that both are fully in compliance with the USMCA obligations and commitments before the President issues a Presidential Proclamation declaring that the USMCA agreement has "entered into force" under U.S. law. While the three countries reportedly are eager to bring the agreement into force this summer, the U.S., Canadian, and Mexican approval and entry into force processes could involve additional delays, uncertainties, or political complications.

The current U.S. Administration also has threatened tougher trade terms with China and other countries, leading to the imposition of substantially higher U.S. Section 301 tariffs on roughly \$380 billion of imports from China. In response, China has imposed higher Chinese tariffs on a large amount of U.S. exports to China, which could affect the prices of U.S. origin parts or components of our products assembled in China. In January 2020, the U.S. and China signed a "Phase One" trade deal pursuant to which, among other things, the U.S. will modify its

Section 301 tariff actions. As part of the Phase One agreement, the U.S. canceled additional Section 301 duties that were originally scheduled to go into effect in December 2019 on certain imported products, including certain of our products, and reduced the duties on certain other imported products, including televisions assembled in China by Roku TV brand partners, from 15% *ad valorem* to 7.5%.

At this time, it is unknown whether and to what extent the USMCA will be ratified by Canada; whether the Phase One deal will last or whether there will be sufficient progress on Phases Two and Three to lead to a further reduction in U.S.-China trade tensions; whether additional Section 301 tariffs will be imposed on Roku products, imported from China and, if so, how long U.S. tariffs on Chinese goods will remain in effect or whether even higher tariffs will be imposed, or new regulatory proposals to restrict trade will be adopted; whether international trade agreements will be negotiated or existing free trade agreements re-negotiated; whether new trade or tariff actions will be announced by the current Administration; or the effect that any such action would have, either positively or negatively, on our industry or our business or licensees. If any new legislation and/or regulations are implemented, or if existing trade agreements are renegotiated or terminated, or if tariffs are imposed on foreign-sourced or U.S. goods, it may be inefficient and expensive for us to alter our business operations in order to adapt to or comply with such changes, and higher prices could depress consumer demand. Such operational changes could have a material adverse effect on our business, financial condition, results of operations or cash flows.

Also, various countries, in addition to the United States, regulate the import and export of certain commodities, software, and technology, including import and export licensing requirements, and have enacted laws that could limit our ability to distribute our products, or collaborate on technology with our commercial or strategic partners, or could limit our commercial and/or strategic partners' ability to implement our products in those countries. Changes in our products or future changes in export and import regulations may create delays in the introduction of our products in international markets, prevent our commercial and/or strategic partners with international operations from deploying our products globally or, in some cases, prevent the export or import of our products to certain countries, governments, or persons altogether. Any change in export or import regulations, the imposition of customs duties on intangible goods such as cross-border data flows which are currently duty-free under the WTO's temporary e-commerce moratorium which faces opposition from certain WTO Members when it comes up for extension at the WTO Ministerial Meeting in June, digital services taxes which potentially could expose certain digital services to new taxes, economic sanctions or related legislation, increased export and import controls stemming governmental policies, or change in the countries, governments, persons or technologies targeted by such regulations, could result in decreased use of our products by, or in our decreased ability to export or sell our products to, existing or new customers in international markets or source components and parts from certain suppliers. Any decreased use of our products or limitation on our ability to export or sell our products, or source parts and components, would harm our business.

Further, following the result of a referendum in 2016, the United Kingdom formally left the EU on January 31, 2020. The United Kingdom's withdrawal from the EU is commonly referred to as "Brexit." Pursuant to the withdrawal arrangements agreed to between the United Kingdom and the EU, the United Kingdom is subject to a transition period until December 31, 2020, during which EU rules will continue to apply (the "Brexit Transition Period"). Negotiations between the United Kingdom and the EU are expected to continue in relation to the customs and trading relationship between the United Kingdom and the EU following the expiry of the Brexit Transition Period. The effects of Brexit have been and are expected to continue to be far-reaching. Brexit and the perceptions as to its impact may adversely affect business activity and economic conditions globally and could continue to contribute to instability in global financial markets. Brexit could also have the effect of disrupting the free movement of goods, services, and people between the United Kingdom and the EU. In addition, Brexit could lead to legal uncertainty and potentially divergent national laws and regulations as the United Kingdom determines which EU laws to replace or replicate. The full effects of Brexit are uncertain and will remain so until after the Brexit Transition Period and the United Kingdom and EU reach a definitive resolution with regards to outstanding trade and legal matters. Given these possibilities and others we may not anticipate, as well as the lack of comparable precedent, the full extent to which our business, results of operations, and financial condition could be adversely affected by Brexit is uncertain.

The supply chains of our contract manufacturers' and many of our licensees may source products, parts or components from China, countries near China and the region. There are many uncertainties around COVID-19, including scientific and health issues, the unknown duration and extent of economic disruption in China and other

markets, and the impact, if any, on the Chinese, U.S., and global economies. As a result, COVID-19 may result in supply shortages of our products or our licensee's products, our ability or our licensee's ability to import, export or sell streaming devices to customers in U.S. and international markets. Any decrease, limitations or delays on our or our licensee's ability to import, export, or sell our streaming devices would harm our business.

If we fail to accurately forecast our manufacturing requirements and manage our inventory with our contract manufacturers, we could incur additional costs, experience manufacturing delays and lose revenue.

We bear supply risk under our contract manufacturing arrangements. Lead times for the materials and components that our contract manufacturers order on our behalf through different component suppliers vary significantly and depend on numerous factors, including the specific supplier, contract terms and market demand for a component at a given time. Lead times for certain key materials and components incorporated into our players or other products are currently lengthy, requiring our contract manufacturers to order materials and components several months in advance. If we overestimate our production requirements, our contract manufacturers may purchase excess components and build excess inventory. If our contract manufacturers, at our request, purchase excess components that are unique to our products or build excess products, we could be required to pay for these excess components or products. In the past, we have agreed to reimburse our contract manufacturers for purchased components that were not used as a result of our decision to discontinue a certain model of player or the use of particular components. If we incur costs to cover excess supply commitments, this would harm our business.

Conversely, if we underestimate our player or other product requirements, our contract manufacturers may have inadequate component inventory, which could interrupt the manufacturing of our players or other products and result in delays or cancellation of orders from retailers and distributors. In addition, from time to time we have experienced unanticipated increases in demand that resulted in the need to ship players via air freight, which is more expensive than ocean freight, and adversely affected our player gross margin during such periods of high demand, for example, during end-of-year holidays. If we fail to accurately forecast our manufacturing requirements, our business may be harmed.

Our players incorporate key components from sole source suppliers and if our contract manufacturer is unable to source these components on a timely basis, due to fabrication capacity issues or other material supply constraints, we will not be able to deliver our players to our retailers and distributors.

We depend on sole source suppliers for key components in our players. Our players utilize specific system on chip, or SoC, Wi-Fi silicon products and Wi-Fi front-end modules from various manufacturers, depending on the player, for which we do not have a second source. Although this approach allows us to maximize player performance on lower cost hardware, reduce engineering qualification costs and develop stronger relationships with our strategic suppliers, this also creates supply chain risk. These sole-source suppliers could be constrained by fabrication capacity issues or material supply issues, such as tariffs on U.S. parts or components for finished players that are used in final assembly of their components, or the risk that the strategic supplier may stop producing such components, cease operations or be acquired by, or enter into exclusive arrangements with, our competitors or other companies. Such suppliers may also face production, shipping, or logistical constraints arising from COVID-19. Any such interruption or delay may force us to seek similar components from alternative sources, which may not be available. Switching from a sole-source supplier would require that we redesign our players to accommodate new components and would require us to re-qualify our players with regulatory bodies, such as the Federal Communications Commission ("FCC"), which would be costly and time-consuming.

Our reliance on sole-source suppliers involves a number of additional risks, including risks related to:

- supplier capacity constraints;
- price increases;
- timely delivery;
- component quality; and
- delays in, or the inability to execute on, a supplier roadmap for components and technologies.

Any interruption in the supply of sole-source components for our players could adversely affect our ability to meet scheduled player deliveries to our retailers and distributors, result in lost sales and higher expenses and harm our business.

If we fail to attract and retain key personnel, effectively manage succession, or hire, develop, and motivate our employees, we may not be able to execute our business strategy or continue to grow our business.

Our success depends in large part on our ability to attract and retain key personnel on our senior management team and in our engineering, research and development, sales and marketing, operations and other organizations. In particular, our founder, President and Chief Executive Officer, Anthony Wood, is critical to our overall management, as well as the continued development of our devices and streaming platform, our culture and our strategic direction. We do not have long-term employment or non-competition agreements with any of our personnel. The loss of one or more of our executive officers or the inability to promptly identify a suitable successor to a key role could have an adverse effect on our business.

Our ability to compete and grow depends in large part on the efforts and talents of our employees. Our employees, particularly engineers and other product developers, are in high demand, and we devote significant resources to identifying, hiring, training, successfully integrating and retaining these employees. Because we face significant competition for personnel, particularly in the San Francisco Bay Area where our headquarters is located, to attract top talent, we have had to offer, and believe we will need to continue to offer, competitive compensation packages before we can validate the productivity of those employees. To retain employees, we also may need to increase our employee compensation levels in response to competition. The loss of employees or the inability to hire additional skilled employees is necessary to support our growth could result in significant disruptions to our business, and the integration of replacement personnel could be time-consuming and expensive and cause disruptions.

We believe a critical component to our success and our ability to retain our best people is our culture. As we continue to grow, we may find it difficult to maintain our entrepreneurial, execution-focused culture. In addition, many of our employees may be able to receive significant proceeds from sales of our equity in the public markets, which may reduce their motivation to continue to work for us. Moreover, the equity ownership of many of our employees could create disparities in wealth among our employees, which may harm our culture and relations among employees and our business.

We need to maintain operational and financial systems that can support our expected growth, increasingly complex business arrangements, and rules governing revenue and expense recognition and any inability or failure to do so could adversely affect our financial reporting, billing and payment services.

We have a complex business that is growing in size and complexity both in the United States and in international jurisdictions. To manage our growth and our increasingly complex business operations, especially as we move into new markets internationally or acquire new businesses, we will need to maintain and may need to upgrade our operational and financial systems and procedures, which requires management time and may result in significant additional expense. Our business arrangements with our content partners, advertisers, Roku TV brand partners and other licensees, and the rules that govern revenue and expense recognition in our business are increasingly complex. To manage the expected growth of our operations and increasing complexity, we must maintain operational and financial systems, procedures and controls and continue to increase systems automation to reduce reliance on manual operations. An inability to do so will negatively affect our financial reporting, billing and payment services. Our current and planned systems, procedures and controls may not be adequate to support our complex arrangements and the rules governing revenue and expense recognition for our future operations and expected growth. Delays or problems associated with any improvement or expansion of our operational and financial systems and controls could adversely affect our relationships with our users, content publishers, advertisers, advertisement agencies, Roku TV brand partners, or other licensees; cause harm to our reputation and brand; and could also result in errors in our financial and other reporting.

We are subject to payment-related risks and, if our advertisers or advertising agencies do not pay or dispute their invoices, our business may be harmed.

Many of our contracts with advertising agencies provide that if the advertiser does not pay the agency, the agency is not liable to us, and we must seek payment solely from the advertiser, a type of arrangement called sequential liability. Contracting with these agencies, which in some cases have or may develop higher-risk credit profiles, may subject us to greater credit risk than if we were to contract directly with advertisers. This credit risk may vary depending on the nature of an advertising agency's aggregated advertiser base. We may also be involved

in disputes with agencies and their advertisers over the operation of our streaming platform or the terms of our agreements. If we are unable to collect or make adjustments to bills, we could incur write-offs for bad debt, which could have a material adverse effect on our results of operations for the periods in which the write-offs occur. In the future, bad debt may exceed reserves for such contingencies and our bad debt exposure may increase over time. Any increase in write-offs for bad debt could have a materially negative effect on our business, financial condition and operating results. If we are not paid by our advertisers or advertising agencies on time or at all, our business may be harmed.

Changes in how network operators manage data that travel across their networks could harm our business.

Our business relies upon the ability of our users to access high-quality streaming content through the internet. As a result, the growth of our business depends on our users' ability to obtain and maintain low-cost, high-speed access to the internet, which relies in part on the network operators' continuing willingness to upgrade and maintain their equipment as needed to sustain a robust internet infrastructure as well as their continued willingness to preserve the open and interconnected nature of the internet. We exercise no control over network operators, which makes us vulnerable to any errors, interruptions or delays in their operations. Any material disruption or degradation in internet services could harm our business.

To the extent that the number of internet users continues to increase, network congestion could adversely affect the reliability of our streaming platform. We may also face increased costs of doing business if network operators engage in discriminatory practices with respect to streamed video content in an effort to monetize access to their networks by data providers. In the past, internet service providers have attempted to implement usage-based pricing, bandwidth caps and traffic "shaping" or throttling. To the extent network operators were to create tiers of internet access service and either charge us for access to these tiers or prohibit our content offerings from being available on some or all of these tiers, our quality of service could decline, our operating expenses could increase and our ability to attract and retain users could be impaired, each of which would harm our business.

In addition, most network operators that provide consumers with access to the internet also provide these consumers with multichannel video programming. These network operators have an incentive to use their network infrastructure in a manner adverse to the continued growth and success of other companies seeking to distribute similar video programming. To the extent that network operators are able to provide preferential treatment to their own data and content, as opposed to ours, our business could be harmed.

Litigation regarding intellectual property rights could result in the loss of rights important to our devices and streaming platform, cause us to incur significant legal costs or otherwise harm our business.

Some internet, technology and media companies, including some of our competitors, own large numbers of patents, copyrights and trademarks, which they may use to assert claims against us. Third parties have asserted, and may in the future assert, that we have infringed, misappropriated or otherwise violated their intellectual property rights. As we face increasing competition, the possibility of intellectual property rights claims against us will grow. Plaintiffs who have no relevant product revenue may not be deterred by our own issued patents and pending patent applications in bringing intellectual property rights claims against us. The cost of patent litigation or other proceedings, even if resolved in our favor, has been or could be substantial. Some of our competitors may be better able to sustain the costs of such litigation or proceedings because of their substantially greater financial resources. Patent litigation and other proceedings may also require significant management time and divert management from our business. Uncertainties resulting from the initiation and continuation of patent litigation or other proceedings could impair our ability to compete in the marketplace. The occurrence of any of the foregoing could harm our business.

As a result of intellectual property infringement claims, or to avoid potential claims, we may choose or be required to seek licenses from third parties. These licenses may not be available on commercially reasonable terms, or at all. Even if we are able to obtain a license, the license would likely obligate us to pay license fees or royalties or both, and the rights granted to us might be nonexclusive, with the potential for our competitors to gain access to the same intellectual property. In addition, the rights that we secure under intellectual property licenses may not include rights to all of the intellectual property owned or controlled by the licensor, and the scope of the licenses granted to us may not include rights covering all of the products and services provided by us and our licensees.

Furthermore, an adverse outcome of a dispute may require us to pay damages, potentially including treble damages and attorneys' fees, if we are found to have willfully infringed a party's intellectual property; cease making, licensing or using technologies that are alleged to infringe or misappropriate the intellectual property of others; expend additional development resources to redesign our solutions; enter into potentially unfavorable royalty or license agreements in order to obtain the right to use necessary technologies, content or materials; and to indemnify our partners and other third parties. In addition, any lawsuits regarding intellectual property rights, regardless of their success, could be expensive to resolve and would divert the time and attention of our management and technical personnel.

Under our agreements with many of our content publishers, licensees, distributors, retailers, contract manufacturers and suppliers, we are required to provide indemnification in the event our technology is alleged to infringe upon the intellectual property rights of third parties.

In certain of our agreements we indemnify our content publishers, licensees, distributors, retailers, manufacturing partners and suppliers. We could incur significant expenses defending these partners if they are sued for patent infringement based on allegations related to our technology. If a partner were to lose a lawsuit and in turn seek indemnification from us, we also could be subject to significant monetary liabilities. In addition, because the devices sold by our licensing partners and TV brands often involve the use of third-party technology, this increases our exposure to litigation in circumstances where there is a claim of infringement asserted against the player in question, even if the claim does not pertain to our technology.

If we fail to protect or enforce our intellectual property or proprietary rights, our business and operating results could be harmed.

We regard the protection of our patents, trade secrets, copyrights, trademarks, trade dress, domain names and other intellectual property or proprietary rights as critical to our success. We strive to protect our intellectual property rights by relying on federal, state and common law rights, as well as contractual restrictions. We seek to protect our confidential proprietary information, in part, by entering into confidentiality agreements and invention assignment agreements with all our employees, consultants, contractors, advisors and any third parties who have access to our proprietary know-how, information or technology. However, we cannot be certain that we have executed such agreements with all parties who may have helped to develop our intellectual property or who had access to our proprietary information, nor can we be certain that our agreements will not be breached. Any party with whom we have executed such an agreement could potentially breach that agreement and disclose our proprietary information, including our trade secrets, and we may not be able to obtain adequate remedies for such breaches. We cannot guarantee that our trade secrets and other confidential proprietary information will not be disclosed or that competitors will not otherwise gain access to our trade secrets or independently develop substantially equivalent information and techniques. Detecting the disclosure or misappropriation of a trade secret and enforcing a claim that a party illegally disclosed or misappropriated a trade secret is difficult, time-consuming and could result in substantial costs and the outcome of such a claim is unpredictable.

Further, the laws of certain foreign countries do not provide the same level of protection of corporate proprietary information and assets such as intellectual property, trademarks, trade secrets, know-how and records as the laws of the United States. For instance, the legal systems of certain countries, particularly certain developing countries, do not favor the enforcement of patents and other intellectual property protection. As a result, we may encounter significant problems in protecting and defending our intellectual property or proprietary rights abroad. Additionally, we may also be exposed to material risks of theft or unauthorized reverse engineering of our proprietary information and other intellectual property, including technical data, manufacturing processes, data sets or other sensitive information. Our efforts to enforce our intellectual property rights in such foreign countries may be inadequate to obtain a significant commercial advantage from the intellectual property that we develop, which could have a material adverse effect on our business, financial condition and results of operations. Moreover, if we are unable to prevent the disclosure of our trade secrets to third parties, or if our competitors independently develop any of our trade secrets, we may not be able to establish or maintain a competitive advantage in our market, which could harm our business.

We have filed and will in the future file patent applications on inventions that we deem to be innovative. There is no guarantee that our patent applications will issue as granted patents, that the scope of the protection gained will be sufficient or that an issued patent may subsequently be deemed invalid or unenforceable. Patent laws,

and scope of coverage afforded by them, have recently been subject to significant changes, such as the change to “first-to-file” from “first-to-invent” resulting from the Leahy-Smith America Invents Act. This change in the determination of inventorship may result in inventors and companies having to file patent applications more frequently to preserve rights in their inventions, which may favor larger competitors that have the resources to file more patent applications. Another change to the patent laws may incentivize third parties to challenge any issued patent in the United States Patent and Trademark Office (“USPTO”), as opposed to having to bring such an action in U.S. federal court. Any invalidation of a patent claim could have a significant impact on our ability to protect the innovations contained within our devices and platform and could harm our business.

The USPTO and various foreign governmental patent agencies require compliance with a number of procedural, documentary, fee payment and other provisions to maintain patent applications and issued patents. We may fail to take the necessary actions and to pay the applicable fees to obtain or maintain our patents. Noncompliance with these requirements can result in abandonment or lapse of a patent or patent application, resulting in partial or complete loss of patent rights in the relevant jurisdiction. In such an event, competitors might be able to use our technologies and enter the market earlier than would otherwise have been the case.

We pursue the registration of our domain names, trademarks and service marks in the United States and in certain locations outside the United States. We are seeking to protect our trademarks, patents and domain names in an increasing number of jurisdictions, a process that is expensive and time-consuming and may not be successful or which we may not pursue in every jurisdiction in which we conduct business.

Litigation may be necessary to enforce our intellectual property or proprietary rights, protect our trade secrets or determine the validity and scope of proprietary rights claimed by others. Any litigation of this nature, regardless of outcome or merit, could result in substantial costs, adverse publicity or diversion of management and technical resources, any of which could adversely affect our business and operating results. If we fail to maintain, protect and enhance our intellectual property or proprietary rights, our business may be harmed.

United States or international rules that permit ISPs to limit internet data consumption by users, including unreasonable discrimination in the provision of broadband internet access services, could harm our business.

Laws, regulations or court rulings that adversely affect the popularity or growth in use of the internet, including decisions that undermine open and neutrally administered internet access, could decrease customer demand for our service offerings, may impose additional burdens on us or could cause us to incur additional expenses or alter our business model.

In February 2015, the FCC adopted open internet rules intended to protect the ability of consumers and content producers to send and receive non-harmful, lawful information on the internet, known as the Open Internet Order. The Open Internet Order prohibited broadband internet access service providers from: (i) blocking access to legal content, applications, services or non-harmful devices; (ii) throttling, impairing or degrading performance based on content, applications, services or non-harmful devices; and (iii) charging more for favorable delivery of content or favoring self-provisioned content over third-party content (collectively, the “prohibited activities”). The Open Internet Order also prohibited broadband internet access service providers from unreasonably interfering with consumers’ ability to select, access and use the lawful content, applications, services or devices of their choosing as well as edge providers’ ability to make lawful content, applications, services or devices available to consumers.

In January 2018, the FCC released a new order, known as the Restoring Internet Freedom Order (the “Order”), that repealed most of the blocking, throttling, and paid prioritization restrictions adopted in the Open Internet Order. The Order reclassified broadband internet access service as a non-common carrier “information service” and repealed rules that had prohibited broadband internet access service providers from conducting the “prohibited activities” but continued to require broadband internet access service providers to be transparent about their policies and network management practices, and subjected discriminatory practices to case-by-case assessment under antitrust and consumer protection laws. Most portions of the Order went into effect in April 2018 and the remainder went into effect in June 2018. Numerous judicial challenges to the Order were filed, and in October 2019, the Court of Appeals for the District of Columbia Circuit upheld nearly all of the Order, but reversed the FCC’s decision to prohibit all state and local regulation targeted at broadband internet access service, requiring case by case

determinations as to whether state and local regulation conflicts with the FCC's rules. The court also required the FCC to reexamine three issues from the Order but allowed the Order to remain in effect pending the FCC's review. The original parties were denied a rehearing by the full D.C. Circuit Court of Appeals in February 2020, but parties may still appeal to the Supreme Court. To the extent the courts, the agencies or the states do not uphold or adopt sufficient safeguards to protect against discriminatory conduct, network operators may seek to extract fees from us or our content publishers to deliver our traffic or otherwise engage in blocking, throttling or other discriminatory practices, and our business could be harmed.

Several states have adopted or are considering network neutrality legislation or regulation. For example, California's legislation codifies portions of the FCC's rescinded Open Internet Order. The U.S. Department of Justice filed suit in September 2018 to block implementation of the California law, and several broadband service provider trade associations also have sued California to invalidate its net neutrality law on grounds that the law is preempted by the Order, among other claims. The status of the preemption claim is uncertain in light of the Court of Appeals decision on the FCC's preemption authority. The California Attorney General agreed to delay implementation of the law until the litigation is resolved. Several states have enacted net neutrality legislation and governors in several other states have signed executive orders requiring broadband internet access service providers contracting with state agencies to adhere to network neutrality principles. The regulatory framework for network neutrality thus remains unsettled and is subject to ongoing Federal and state legislative and regulatory activity. Moreover, the FCC's legal authority and willingness to preempt state net neutrality laws on a case-by-case basis remain unsettled. If the FCC preempts individual state net neutrality laws that prohibit blocking, throttling, and other discriminatory practices, our business could be harmed.

As we expand internationally, government regulation protecting the non-discriminatory provision of internet access may be nascent or non-existent. In those markets where regulatory safeguards against unreasonable discrimination are nascent or non-existent and where local network operators possess substantial market power, we could experience anti-competitive practices that could impede our growth, cause us to incur additional expenses or otherwise harm our business. Future regulations or changes in laws and regulations or their existing interpretations or applications could also hinder our operational flexibility, raise compliance costs and result in additional liabilities for us, which may harm our business.

Broadband internet providers are subject to government regulation and enforcement actions, and changes in current or future laws, regulations or enforcement actions that negatively impact our distributors or content publishers could harm our business.

Upon the effective date of the FCC's Restoring Internet Freedom Order, the FTC became the federal agency primarily responsible for regulating broadband privacy and data security in the United States. The FTC follows an enforcement-focused approach to regulating broadband privacy and security. Future FTC enforcement actions could cause us or our content publishers to alter advertising claims or alter or eliminate certain features or functionalities of our products or services which may harm our business. At the FCC, many broadband internet providers provide traditional telecommunications services that are subject to FCC and state rate regulation of intrastate telecommunications services, and are recipients of federal universal service fund payments, which are intended to subsidize telecommunications services in areas that are expensive to serve. Changes in rate regulations or in universal service funding rules, either at the federal or state level, could affect these broadband internet providers' revenue and capital spending plans. In addition, various international regulatory bodies have jurisdiction over non-United States broadband internet providers. The Nevada SPI Law and the CCPA also apply to broadband internet providers that do business in Nevada and California, respectively. To the extent these broadband internet providers are adversely affected by laws or regulations regarding their business, products or service offerings, our business could be harmed.

If we are found liable for content that is distributed through or advertising that is served through our platform, our business could be harmed.

As a distributor of content, we face potential liability for negligence, copyright, patent or trademark infringement, public performance royalties or other claims based on the nature and content of materials that we distribute. The Digital Millennium Copyright Act (the "DMCA") is intended, in part, to limit the liability of eligible service providers for caching, hosting or linking to, user content that includes materials that infringe copyrights or other rights. We rely on the protections provided by the DMCA in conducting our business. However, the DMCA

and similar statutes and doctrines that we may rely on in the future is subject to uncertain judicial interpretation and regulatory and legislative amendments. Moreover, the DMCA provides protection primarily in the United States. If the rules around these statutes and doctrines change, if international jurisdictions refuse to apply similar protections or if a court were to disagree with our application of those rules to our business, we could incur liability and our business could be harmed. If we become liable for these types of claims as a result of the content that is streamed over our platform, then our business may suffer. Litigation to defend these claims could be costly and the expenses and damages arising from any liability could harm our business. Our insurance may not be adequate to cover these types of claims or any liability that may be imposed on us.

In addition, regardless of any legal protections that may limit our liability for the actions of third parties, we may be adversely impacted if copyright holders assert claims, or commence litigation, alleging copyright infringement against the developers of channels that are distributed on our platform. While our platform policies prohibit streaming content on our platform without distribution rights from the copyright holder, and we maintain processes and systems for the reporting and removal of infringing content, in certain instances our platform has been misused by unaffiliated third parties to unlawfully distribute copyrighted content. If content owners or distributors are influenced by the existence of types of claims or proceedings and are deterred from working with us as a consequence, this could impair our ability to maintain or expand our business, including through international expansion plans.

Our involvement in any such legal matters now or in the future, could cause us to incur significant legal expenses and other costs, and be disruptive to our business.

Our streaming devices are technically complex and may contain undetected hardware errors or software bugs, which could manifest themselves in ways that could harm our reputation and our business.

Our streaming devices and those of our licensees are technically complex and have contained and may in the future contain undetected software bugs or hardware errors. These bugs and errors can manifest themselves in any number of ways in our devices or our streaming platform, including through diminished performance, security vulnerabilities, data quality in logs or interpretation of data, malfunctions or even permanently disabled devices. Some errors in our devices may only be discovered after a device has been shipped and used by users and may in some cases only be detected under certain circumstances or after extended use. We also update the Roku OS and our software on a regular basis, and, despite our quality assurance processes, we could introduce bugs in the process of any such update. The introduction of a serious software bug could result in devices becoming permanently disabled. We offer a limited one year warranty in the United States and any such defects discovered in our products after commercial release could result in loss of revenue or delay in revenue recognition, loss of customer goodwill and users and increased service costs, any of which could harm our business, operating results and financial condition. We could also face claims for product or information liability, tort or breach of warranty, or other violations of laws or regulations. In addition, our contracts with users contain provisions relating to warranty disclaimers and liability limitations, which may not be upheld. Defending a lawsuit, regardless of its merit, is costly and may divert management's attention and adversely affect the market's perception of Roku and our products. In addition, if our insurance coverage proves inadequate or future coverage is unavailable on acceptable terms or at all, our business could be harmed.

Components used in our products may fail as a result of manufacturing, design or other defects over which we have no control and render our devices permanently inoperable.

We rely on third-party component suppliers to provide certain functionalities needed for the operation and use of our products. Any errors or defects in such third-party technology could result in errors in our products that could harm our business. If these components have a manufacturing, design or other defect, they can cause our products to fail and render them permanently inoperable. For example, the typical means by which our users connect their home networks to our players is by way of a Wi-Fi access point in the home network router. If the Wi-Fi receiver in our player fails, then our player cannot detect a home network's Wi-Fi access point, and our player will not be able to display or deliver any content to the TV screen. As a result, we may have to replace these players at our sole cost and expense. Should we have a widespread problem of this kind, our reputation in the market could be adversely affected and our replacement of these players would harm our business.

If we experience higher player returns than we expect and are unable to resell such returned players as refurbished players, our business could be harmed.

We offer customers who purchase players through our website 30 days to return such players. We also generally honor the return policies of our retail and distribution partners, who typically allow customers to return players, even with open packaging within certain time periods that may exceed 30 days. We generally resell any returned players as refurbished players. To the extent we experience a greater number of returns than we expect, are unable to resell returned players as refurbished players, or are required to provide price protection in amounts greater than we expect, our business could be harmed.

If we are unable to obtain necessary or desirable third-party technology licenses, our ability to develop new streaming players or platform enhancements may be impaired.

We utilize commercially available off-the-shelf technology in the development of our players and streaming platform. As we continue to introduce new features or improvements to our players and our streaming platform, we may be required to license additional technologies from third parties. These third-party licenses may be unavailable to us on commercially reasonable terms, if at all. If we are unable to obtain necessary third-party licenses, we may be required to obtain substitute technologies with lower quality or performance standards, or at a greater cost, any of which could harm the competitiveness of our players, streaming platform and our business.

Our use of open source software could impose limitations on our ability to commercialize our devices and our streaming platform.

We incorporate open source software in our streaming platform. From time to time, companies that incorporate open source software into their products and services have faced claims challenging the ownership of open source software and/or compliance with open source license terms. Therefore, we could be subject to suits by parties claiming ownership of what we believe to be open source software or noncompliance with open source licensing terms. Although we monitor our use of open source software, the terms of many open source software licenses have not been interpreted by U.S. courts, and there is a risk that such licenses could be construed in a manner that could impose unanticipated conditions or restrictions on the sale of our devices. In such event, we could be required to make our proprietary software generally available to third parties, including competitors, at no cost, to seek licenses from third parties in order to continue offering our devices, to re-engineer our devices or to discontinue the sale of our devices in the event re-engineering cannot be accomplished on a timely basis or at all, any of which could harm our business.

The quality of our customer support is important to our users and licensees, and, if we fail to provide adequate levels of customer support, we could lose users and licensees, which would harm our business.

Our users and licensees depend on our customer support organization to resolve any issues relating to our devices. A high level of support is critical for the successful marketing and sale of our devices. We currently outsource our customer support operation to a third-party customer support organization. If we do not effectively train, update and manage our third-party customer support organization to assist our users, and if that support organization does not succeed in helping them quickly resolve issues or provide effective ongoing support, it could adversely affect our ability to sell our devices to users and harm our reputation with potential new users and our licensees.

If we fail to maintain effective internal control over financial reporting, investors may lose confidence in the accuracy and completeness of our financial reports and the market price of our Class A common stock may be adversely affected.

We are required to maintain internal control over financial reporting and to report any material weaknesses in such internal control. Section 404 of the Sarbanes-Oxley Act of 2002 ("Section 404") requires that we furnish a report by management on, among other things, the effectiveness of our internal control over financial reporting. This assessment must include disclosure of any material weaknesses identified by our management in our internal control over financial reporting. Our independent registered public accounting firm also attests to the effectiveness of our internal control over financial reporting. If we have a material weakness in our internal control over financial reporting in the future, we may not detect errors on a timely basis and our financial statements may be materially misstated. If we identify material weaknesses in our internal control over financial reporting, are unable to continue

to comply with the requirements of Section 404 in a timely manner, are unable to assert that our internal control over financial reporting is effective, or if our independent registered public accounting firm is unable to express an opinion as to the effectiveness of our internal control over financial reporting, investors may lose confidence in the accuracy and completeness of our financial reports, and the market price of our Class A common stock could be adversely affected. In addition, we could become subject to investigations by the stock exchange on which our Class A common stock is listed, the SEC, or other regulatory authorities, which could require additional financial and management resources.

Our financial results may be adversely affected by changes in accounting principles applicable to us.

Generally accepted accounting principles in the United States ("U.S. GAAP") are subject to interpretation by the Financial Accounting Standards Board (the "FASB"), the SEC, and other various bodies formed to promulgate and interpret appropriate accounting principles. A change in these principles or interpretations could have a significant effect on our reported results of operations and may even affect the reporting of transactions completed before the announcement or effectiveness of a change. For example, we adopted Accounting Standards Codification, *Revenue from Contracts with Customers (Topic 606)* ("ASC 606"), using the modified retrospective method. We applied the revenue standard to all contracts that were not completed as of January 1, 2018. We recognized the cumulative effect of initially applying the revenue standard as an adjustment to the opening balance of retained earnings. The comparative information has not been restated and continues to be reported under the accounting standards in effect for the prior periods. It is difficult to predict the impact of future changes to accounting principles or our accounting policies, any of which could harm our business.

We may pursue acquisitions, which involve a number of risks, and if we are unable to address and resolve these risks successfully, such acquisitions could harm our business.

We recently acquired dataxu, Inc. and may in the future acquire businesses, products or technologies to expand our offerings and capabilities, user base and business. We have evaluated, and expect to continue to evaluate, a wide array of potential strategic transactions; however, we have limited experience completing or integrating acquisitions. Any acquisition could be material to our financial condition and results of operations and any anticipated benefits from an acquisition may never materialize. Acquisitions could also result in dilutive issuances of equity securities or the incurrence of debt, which could adversely affect our operating results, may cause unfavorable accounting treatment, may expose us to claims and disputes by third parties, including intellectual property claims, and may not generate sufficient financial returns to offset additional costs and expenses related to the acquisitions. In addition, the process of integrating acquired businesses, products or technologies may create unforeseen operating difficulties and expenditures. Acquisitions of businesses, products or technologies in international markets would involve additional risks, including those related to integration of operations across different cultures and languages, currency risks and the particular economic, political and regulatory risks associated with specific countries. We may not be able to address these risks successfully, or at all, without incurring significant costs, delays or other operational problems and if we were unable to address such risks successfully our business could be harmed.

We have outstanding debt and our credit facility provides our lender with a first-priority lien against substantially all of our assets and contains financial covenants and other restrictions on our actions that may limit our operational flexibility or otherwise adversely affect our financial condition.

We entered into a credit agreement among us, as borrower, the lenders and issuing banks from time to time party thereto, and Morgan Stanley Senior Funding, Inc., or the Agent providing for a (i) a four-year revolving credit facility in the aggregate principal amount of up to \$100.0 million, (the "Revolving Credit Facility"), (ii) a four-year delayed draw term loan A facility in the aggregate principal amount of up to \$100.0 million, (the "Term Loan A Facility") and (iii) an uncommitted incremental facility subject to certain conditions (collectively, the "Credit Agreement"). The Credit Agreement contains a number of affirmative and negative covenants, which may restrict our current and future operations, particularly our ability to respond to certain changes in our business or industry or take future actions. The Credit Agreement also contains a financial covenant requiring us to maintain a minimum adjusted quick ratio of at least 1.00 to 1.00, tested as of the last day of any fiscal quarter on the basis of the prior period of our four consecutive fiscal quarters. Pursuant to the Credit Agreement, we granted the Agent a security interest in substantially all of our assets. See the section titled "Management's Discussion and Analysis of Financial

Condition and Results of Operations—Liquidity and Capital Resources—Senior Secured Term Loan A and Revolving Credit Facilities.”

In November 2019, we borrowed \$100.0 million aggregate principal amount pursuant to the Term Loan A Facility. As of December 31, 2019, we were in compliance with the financial covenants. However, if we fail to comply with the covenants, make payments as specified in the Credit Agreement, or undergo any other event of default contained in the Credit Agreement, the Agent could declare an event of default, which would give it the right to terminate the commitments to provide additional loans and declare any borrowings outstanding, together with accrued and unpaid interest and fees, to be immediately due and payable. In addition, the Agent would have the right to proceed against the assets we provided as collateral pursuant to the Credit Agreement. If the outstanding debt under the Credit Agreement is accelerated, we may not have sufficient cash or be able to sell sufficient assets to repay it, which would harm our business and financial condition.

When we borrowed pursuant to the Term Loan A Facility, we choose LIBOR as the benchmark for establishing the applicable interest rate. LIBOR is the subject of recent national, international and other regulatory guidance and proposals for reform which may cause LIBOR to cease to exist, establish new methods of calculating LIBOR, or replace LIBOR with an alternative reference rate(s). The consequences of these developments cannot be entirely predicted and could have an adverse impact on the value of our LIBOR-linked financial obligations, such as an increase in the cost of our credit agreement indebtedness.

If we fail to comply with the laws and regulations relating to the collection of sales tax and payment of income taxes in the various jurisdictions in which we do business, we could be exposed to unexpected costs, expenses, penalties and fees as a result of our noncompliance, which could harm our business.

By engaging in business activities in the United States, we become subject to various jurisdiction laws and regulations, including requirements to collect sales tax from our sales within those jurisdictions, and the payment of income taxes on revenue generated from activities in those jurisdictions. The laws and regulations governing the collection of sales tax for sales on our website and payment of income taxes are numerous, complex, and vary by jurisdiction. A successful assertion by one or more jurisdictions that we were required to collect sales or other taxes or to pay income taxes where we did not could result in substantial tax liabilities, fees and expenses, including substantial interest and penalty charges, which could harm our business.

New legislation that would change U.S. or foreign taxation of international business activities or other tax-reform policies could harm our business.

Reforming the taxation of international businesses has been a priority for U.S. politicians, and key members of the legislative and executive branches, and a wide variety of changes has been proposed or enacted. Certain changes to U.S. tax laws could affect the tax treatment of our foreign earnings, as well as cash and cash equivalent balances we maintain outside the United States. Additionally, any changes in the U.S. or foreign taxation of such activities may increase our worldwide effective tax rate and the amount of taxes we pay and harm our business.

For example, the Tax Cuts and Jobs Act (“TCJA”) was enacted in December 2017 and significantly reformed the Internal Revenue Code of 1986, as amended. The TCJA, among other things, included changes to U.S. federal tax rates, imposes additional limitations on the deductibility of interest, has both positive and negative changes to the utilization of future net operating loss carryforwards, allows for the expensing of certain capital expenditures, and puts into effect the migration from a “worldwide” system of taxation to a territorial system. The U.S. Department of Treasury has broad authority to issue regulations and interpretative guidance that may significantly impact how we will apply the law, which could affect our financial position and result of operations.

In addition, an increasing number of jurisdictions are considering or have adopted laws or administrative practices that impose new tax measures, including revenue-based taxes targeting online commerce and the remote selling of goods and services. These include new obligations to collect sales, consumption, value added, or other taxes on online marketplaces and remote sellers, or other requirements that may result in liability for third-party obligations. For example, the EU, certain member states, and other countries have proposed or enacted taxes on digital advertising and marketplace service revenues. Our results of operations and cash flows could be adversely

affected by additional taxes of this nature imposed on us prospectively or retroactively or additional taxes or penalties resulting from the failure to comply with any collection obligations.

We continue to examine the impact these and other tax reforms may have on our business. The impact of these and other tax reforms is uncertain and one or more of these or similar measures could seriously harm our business.

We may require additional capital to meet our financial obligations and support planned business growth, and this capital might not be available on acceptable terms or at all.

We intend to continue to make significant investments to support planned business growth and may require additional funds to respond to business challenges, including the need to develop new devices and enhance our streaming platform, maintain adequate levels of inventory to support our retail partners' demand requirements, improve our operating infrastructure or acquire complementary businesses, personnel and technologies. Our primary uses of cash include operating costs such as personnel-related expenses and capital spending. Our future capital requirements may vary materially from those currently planned and will depend on many factors including our growth rate and the continuing market acceptance of our streaming platform, the Roku OS and players along with the timing and effort related to the introduction of new platform features, players, hiring of experienced personnel, the expansion of sales and marketing activities, as well as overall economic conditions. For example, we entered into lease agreements for a corporate headquarters, and we started to incur material expenses during 2019. On November 8, 2019 we acquired dataxu, Inc. for aggregate consideration of \$78.7 million in cash and 571,459 shares of our Class A common stock.

We may need to engage in equity or debt financings to secure additional funds. If we raise additional funds through future issuances of equity or convertible debt securities, our then existing stockholders could suffer significant dilution, and any new equity securities we issue could have rights, preferences and privileges superior to those of holders of our Class A common stock. Any debt financing we secure could involve additional restrictive covenants relating to our capital raising activities and other financial and operational matters, which may make it more difficult for us to obtain additional capital and to pursue business opportunities, including potential acquisitions. If we were to violate such restrictive covenants, we could incur penalties, increased expenses and an acceleration of the payment terms of our outstanding debt, which could in turn harm our business.

We may not be able to obtain additional financing on terms favorable to us, if at all. If we are unable to obtain adequate financing or financing on terms satisfactory to us when we require it, our ability to continue to support our business growth and to respond to business challenges could be significantly impaired, and our business may be harmed.

Natural disasters or other catastrophic events could disrupt and impact our business.

Occurrence of any catastrophic event, including earthquake, flood, tsunami or other weather event, power loss, internet failure, software or hardware malfunctions, cyber-attack, war, terrorist attack, medical epidemic or pandemic, other man-made disasters or other catastrophic events could disrupt our business operations. Any of these business disruptions could require substantial expenditures and recovery time in order to fully resume operations. In particular, our principal offices are located in California, our contract manufacturers and some of our suppliers are located in Asia both of which are regions known for seismic activity making our operations in these areas vulnerable to natural disasters or other business disruptions in these areas. Our insurance coverage may not compensate us for losses that may occur in the event of an earthquake or other significant natural disaster. In addition, acts of terrorism could cause disruptions to the internet or the economy as a whole. If our streaming platform was to fail or be negatively impacted as a result of a natural disaster or other event, our ability to deliver streaming content, including advertising, to our users would be impaired. Disruptions in the operations of our contract manufacturers as a result of a disaster or other catastrophic event could delay the manufacture and shipment of our players or other products, which could impact our business. If we are unable to develop adequate plans to ensure that our business functions continue to operate during and after a disaster or other catastrophic event and to execute successfully on those plans in the event of a disaster or catastrophic event, our business would be harmed.

Risks Related to Ownership of Our Class A Common Stock

The dual class structure of our common stock as contained in our amended and restated certificate of incorporation has the effect of concentrating voting control with those stockholders who held our stock prior to our initial public offering, including our executive officers, employees and directors and their affiliates, and limiting your ability to influence corporate matters.

Our Class B common stock has 10 votes per share, and our Class A common stock has one vote per share. Our President and Chief Executive Officer, Anthony Wood, holds and controls the vote of a significant number of shares of our outstanding common stock, and therefore Mr. Wood will have significant influence over our management and affairs and over all matters requiring stockholder approval, including election of directors and significant corporate transactions, such as a merger or other sale of Roku or our assets, for the foreseeable future. If Mr. Wood's employment with us is terminated, he will continue to have the same influence over matters requiring stockholder approval.

In addition, the holders of Class B common stock collectively will continue to be able to control all matters submitted to our stockholders for approval even if their stock holdings represent less than 50% of the outstanding shares of our common stock. Because of the 10-to-1 voting ratio between our Class B and Class A common stock, the holders of our Class B common stock collectively will continue to control a majority of the combined voting power of our common stock even when the shares of Class B common stock represent as little as 10% of all outstanding shares of our Class A and Class B common stock. This concentrated control will limit your ability to influence corporate matters for the foreseeable future, and, as a result, the market price of our Class A common stock could be adversely affected.

Future transfers by holders of Class B common stock will generally result in those shares converting to Class A common stock, which will have the effect, over time, of increasing the relative voting power of those holders of Class B common stock who retain their shares in the long term. As a result of such transfers, as of December 31, 2019, Mr. Wood controls a majority of the combined voting power of our Class A and Class B common stock even though he only owns 15.8% of the outstanding Class A and Class B common stock. As a board member, Mr. Wood owes a fiduciary duty to our stockholders and must act in good faith in a manner he reasonably believes to be in the best interests of our stockholders. As a stockholder, even a controlling stockholder, Mr. Wood is entitled to vote his shares in his own interests, which may not always be in the interests of our stockholders generally. This concentrated control could delay, defer, or prevent a change of control, merger, consolidation, or sale of all or substantially all of our assets that our other stockholders support, or conversely this concentrated control could result in the consummation of such a transaction that our other stockholders do not support. This concentrated control could also discourage a potential investor from acquiring our Class A common stock, which has limited voting power relative to the Class B common stock and might harm the trading price of our Class A common stock.

We have not elected to take advantage of the "controlled company" exemption to the corporate governance rules for companies listed on The Nasdaq Global Select Market.

The trading price of our Class A common stock has been, and may continue to be, volatile, and the value of our Class A common stock may decline.

The market price of our Class A common stock has been and may continue to be subject to wide fluctuations in response to numerous factors, many of which are beyond our control, including:

- actual or anticipated fluctuations in our financial condition and operating results;
- changes in projected operational and financial results;
- loss by us of key content publishers;
- changes in laws or regulations applicable to our devices or platform;
- the commencement or conclusion of legal proceedings that involve us;
- actual or anticipated changes in our growth rate relative to our competitors;
- announcements of new products or services by us or our competitors;
- announcements by us or our competitors of significant acquisitions, strategic partnerships, joint ventures or capital-raising activities or commitments;

- additions or departures of key personnel;
- issuance of new or updated research or reports by securities analysts;
- the use by investors or analysts of third-party data regarding our business that may not reflect our financial performance;
- fluctuations in the valuation of companies perceived by investors to be comparable to us;
- sales of our Class A common stock;
- share price and volume fluctuations attributable to inconsistent trading volume levels of our shares; and
- general economic and market conditions.

Furthermore, the stock markets frequently experience extreme price and volume fluctuations that affect the market prices of equity securities of many companies. These fluctuations often have been unrelated or disproportionate to the operating performance of those companies. These broad market and industry fluctuations, as well as general economic, political and market conditions such as recessions, elections, interest rate changes or international currency fluctuations, may negatively impact the market price of our Class A common stock. As a result of such fluctuations, you may not realize any return on your investment in us and may lose some or all of your investment. In the past, companies that have experienced volatility in the market price of their stock have been subject to securities class action litigation. We may be the target of this type of litigation in the future, which could result in substantial costs and divert our management's attention from other business concerns.

Future sales and issuances of our capital stock or rights to purchase capital stock could result in additional dilution of the percentage ownership of our stockholders and could cause our stock price to decline.

We may issue additional securities in the future and from time to time. Future sales and issuances of our capital stock or rights to purchase our capital stock could result in substantial dilution to our existing stockholders. We may sell or issue Class A common stock, convertible securities and other equity securities in one or more transactions at prices and in a manner as we may determine from time to time. If we sell any such securities in subsequent transactions, investors may be materially diluted. New investors in such subsequent transactions could gain rights, preferences and privileges senior to those of holders of our Class A common stock.

Future sales of shares by existing stockholders could cause our stock price to decline.

If our existing stockholders sell, or indicate an intention to sell, substantial amounts of our Class A common stock in the public market, the trading price of our Class A common stock could decline. All of our outstanding Class A shares are eligible for sale in the public market, other than shares and options exercisable held by directors, executive officers and other affiliates that are subject to volume limitations under Rule 144 of the Securities Act. In addition, we have reserved shares for future issuance under our equity incentive plan. Our employees, other service providers, and directors are subject to our quarterly trading window, which generally opens at the start of the second full trading day after the public dissemination of our annual or quarterly financial results and closes (i) with respect to the first, second and third quarter of each year, at the end of the fifteenth day of the last month of the such quarter and (ii) with respect to the fourth quarter of each year, at the end of the trading day on the Wednesday before Thanksgiving. These employees, service providers and directors may also sell shares during a closed window periods pursuant to trading plans that comply with the requirements of Rule 10b5-1(c)(1) under the Exchange Act. When these shares are issued and subsequently sold, it would be dilutive to existing stockholders and the trading price of our Class A common stock could decline.

If securities or industry analysts do not publish research or publish unfavorable research about our business or if they downgrade our stock, our stock price and trading volume could decline.

A limited number of equity research analysts provide research coverage of our Class A common stock, and we cannot assure you that such equity research analysts will adequately provide research coverage of our Class A common stock. A lack of adequate research coverage may adversely affect the liquidity and market price of our Class A common stock. If securities or industry analysts cover our company and one or more of these analysts downgrades our stock or issues other unfavorable commentary or research, the price of our Class A common stock could decline. If one or more equity research analysts cease coverage of our company, or fail to publish reports on us regularly, demand for our stock could decrease, which in turn could cause our stock price or trading volume to decline.

We incur costs and demands upon management as a result of complying with the laws and regulations affecting public companies in the United States, which may harm our business.

As a public company listed in the United States, we incur significant legal, accounting and other expenses. In addition, changing laws, regulations and standards relating to corporate governance and public disclosure, including regulations implemented by the SEC and The Nasdaq Global Select Market, may increase legal and financial compliance costs and make some activities more time consuming. These laws, regulations and standards are subject to varying interpretations and, as a result, their application in practice may evolve over time as new guidance is provided by regulatory and governing bodies. We intend to invest resources to comply with evolving laws, regulations and standards, and this investment may result in increased general and administrative expenses and a diversion of management's time and attention from revenue-generating activities to compliance activities. If, notwithstanding our efforts, we fail to comply with new laws, regulations and standards, regulatory authorities may initiate legal proceedings against us, and our business may be harmed.

Failure to comply with these rules might also make it more difficult for us to obtain certain types of insurance, including director and officer liability insurance, and we might be forced to accept reduced policy limits and coverage or incur substantially higher costs to obtain the same or similar coverage. The impact of these events could also make it more difficult for us to attract and retain qualified persons to serve on our Board of Directors, on committees of our Board of Directors or as members of senior management.

We do not intend to pay dividends in the foreseeable future.

We have never declared or paid any cash dividends on our Class A or Class B common stock and do not intend to pay any cash dividends in the foreseeable future. We anticipate that we will retain all of our future earnings to grow our business and for general corporate purposes. Moreover, our outstanding Credit Agreement contains prohibitions on the payment of cash dividends on our capital stock. Accordingly, investors must rely on sales of their Class A common stock after price appreciation, which may never occur, as the only way to realize any future gains on their investments.

Provisions in our corporate charter documents and under Delaware law may prevent or frustrate attempts by our stockholders to change our management or hinder efforts to acquire a controlling interest in us, and the market price of our Class A common stock may be lower as a result.

There are provisions in our certificate of incorporation and bylaws that may make it difficult for a third-party to acquire, or attempt to acquire, control of Roku, even if a change in control was considered favorable by our stockholders.

Our charter documents also contain other provisions that could have an anti-takeover effect, such as:

- establishing a classified Board of Directors so that not all members of our Board of Directors are elected at one time;
- permitting the Board of Directors to establish the number of directors and fill any vacancies and newly created directorships;
- providing that directors may only be removed for cause;
- prohibiting cumulative voting for directors;
- requiring super-majority voting to amend some provisions in our certificate of incorporation and bylaws;
- authorizing the issuance of "blank check" preferred stock that our Board of Directors could use to implement a stockholder rights plan;
- eliminating the ability of stockholders to call special meetings of stockholders;
- prohibiting stockholder action by written consent, which requires all stockholder actions to be taken at a meeting of our stockholders; and
- reflecting our two classes of common stock as described above.

Moreover, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporation Law, which prohibit a person who owns 15% or more of our outstanding voting stock from merging or combining with us for a period of three years after the date of the transaction in which the person acquired in excess of 15% of our outstanding voting stock, unless the merger or combination is approved in a

prescribed manner. Any provision in our certificate of incorporation or our bylaws or Delaware law that has the effect of delaying or deterring a change in control could limit the opportunity for our stockholders to receive a premium for their shares of our Class A common stock and could also affect the price that some investors are willing to pay for our Class A common stock.

Our amended and restated certificate of incorporation provides that the Court of Chancery of the State of Delaware and the federal district courts of the United States of America will be the exclusive forums for substantially all disputes between us and our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us or our directors, officers or employees.

Our amended and restated certificate of incorporation provides that the Court of Chancery of the State of Delaware is the exclusive forum for any derivative action or proceeding brought on our behalf; any action asserting a breach of fiduciary duty; any action asserting a claim against us arising pursuant to the Delaware General Corporation Law, our amended and restated certificate of incorporation or our bylaws; or any action asserting a claim against us that is governed by the internal affairs doctrine. This exclusive-forum provision, if permitted by applicable law, may limit a stockholder's ability to bring a claim in a judicial forum that it finds favorable for certain disputes with us or our directors, officers or other employees, which may discourage lawsuits against us and our directors, officers and other employees. If a court were to find this exclusive-forum provision in our amended and restated certificate of incorporation to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving such action in other jurisdictions, which could harm our business.

Our amended and restated certificate of incorporation further provides that the federal district courts of the United States of America will be the exclusive forum for resolving any complaint asserting a cause of action arising under the Securities Act. In December 2018, the Delaware Chancery Court issued an opinion invalidating such provision which we have appealed to the Supreme Court of the State of Delaware. Until a final resolution is reached on this matter, we will not attempt to enforce this provision of our certificate of incorporation. As a result, we may incur additional costs associated with resolving disputes that would otherwise be restricted by that provision in other jurisdictions, which could harm our business.

Item 1B. Unresolved Staff Comments

None.

Item 2. Properties

Our corporate headquarters are currently located in Los Gatos, California under a lease that expires in March 2020. We use this space for sales, research and development and administrative purposes. In 2018, we entered into lease agreements for office space in San Jose, California to house our new headquarters. The lease includes multiple buildings and we commenced occupancy in the first building in 2019 and intend to complete our move into the new headquarters in March 2020. In addition, we maintain other offices in the United States in New York, Boston, Austin, Chicago, and Santa Monica and outside of the United States in the United Kingdom, China and Denmark. We believe that our facilities are suitable to meet our current needs.

Item 3. Legal Proceedings

Information with respect to this item may be found in Note 12 to the Consolidated Financial Statements in Item 8, which is incorporated herein by reference.

Item 4. Mine Safety Disclosures

None

PART II

Item 5. Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities**Market Information**

Our Class A common stock is listed on The Nasdaq Global Select Market under the ticker symbol "ROKU." Our Class B common stock is not listed or traded on any exchange.

Holders of Record

As of January 31, 2020, there were 68 stockholders of record of our Class A common stock. This figure does not include a substantially greater number of beneficial holders of our common stock whose shares are held of record by banks, brokers and other financial institutions. As of January 31, 2020, there were approximately 30 stockholders of record of our Class B common stock.

Dividend Policy

We have never declared or paid dividends on our common stock. We intend to retain any future earnings for use in our business and therefore we do not anticipate declaring or paying any cash dividends in the foreseeable future. The terms of our Credit Facility also restrict our ability to pay dividends, and we may also enter into credit agreements or other borrowing arrangements in the future that will restrict our ability to declare or pay cash dividends on our capital stock.

Sale of Unregistered Securities and Use of Proceeds**(a) Unregistered Sale of Equity Securities**

None.

(b) Use of Proceeds

On September 27, 2017, our registration statement on Form S-1 (No. 333-220318) was declared effective by the SEC for our initial public offering ("IPO") of Class A common stock. On October 2, 2017, we closed our IPO, in which we issued and sold 10.4 million shares of our Class A common stock at a public offering price of \$14.00 per share, for net proceeds of approximately \$134.8 million, after deducting underwriting discounts and commissions of \$10.1 million. We incurred offering cost of \$3.1 million. No payments for such expenses were made directly or indirectly to (i) any of our officers or directors or their associates, (ii) any persons owning 10% or more of any class of our equity securities, or (iii) any of our affiliates. The offer and sale of all of the shares in the IPO were registered under the Securities Act pursuant to a registration statement on Form S-1 (No. 333-220318), which was declared effective by the SEC on September 27, 2018. Following the sale of the shares in connection with the closings of the IPO, the offering terminated.

As of December 31, 2019, we have used the entirety of the net proceeds from our IPO.

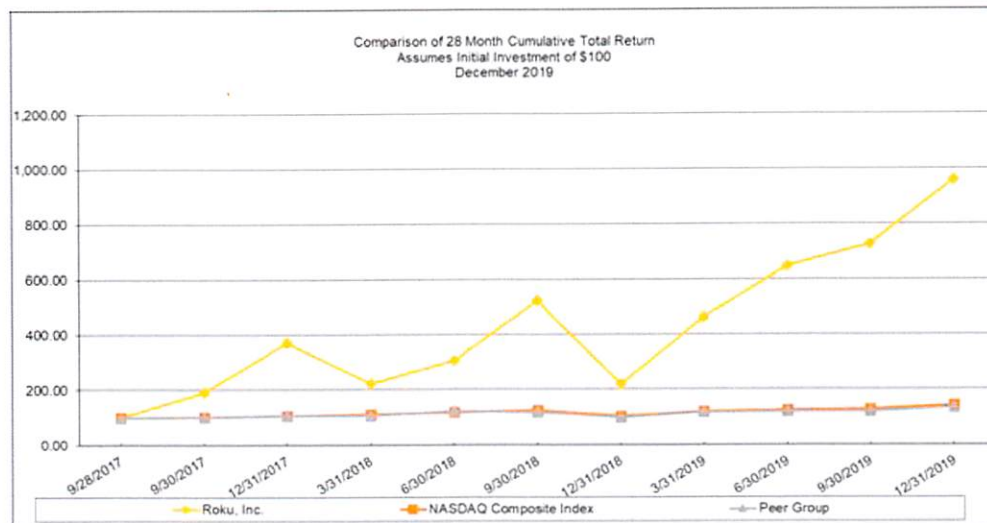
Stock Performance Graphs and Cumulative Total Return

This performance graph shall not be deemed "filed" with the SEC for purposes of Section 18 of the Exchange Act, or incorporated by reference into any filing of Roku, Inc., under the Securities Act.

The following graph shows the cumulative total stockholder return of an investment of \$100 in cash from September 29, 2017 (the date our Class A common stock commenced trading on The Nasdaq Global Select Market) through December 31, 2019, for (i) our Class A common stock, (ii) the Nasdaq Composite Index and (iii) the Peer Group of companies. Because no published index of comparable player and platform companies is currently available, we have used Peer Group of companies for the purposes of this graph in accordance with the requirements of the SEC. The Peer Group is made up of Facebook, Inc., Alphabet, Inc., Logitech International S.A., Netflix, Inc.,

Snap, Inc., Twitter, Inc., Yelp, Inc. and Zillow Group, Inc. Not all of the companies included in Peer Group participate in all the lines of business in which we are engaged, and some of the companies are engaged in lines of business in which we do not participate. Additionally, the market capitalization of some of the companies included in the Peer Group are different from ours.

Pursuant to applicable SEC rules, all values assume reinvestment of the full amount of all dividends, however no dividends have been declared on our common stock to date. The stockholder return shown on the graph below is not necessarily indicative of future performance, and we do not make or endorse any predictions as to future stockholder returns.



Company name / Index	9/28/17	9/30/17	12/31/17	3/31/18	6/30/18	9/30/18	12/31/18	3/31/19	6/30/19	9/30/19	12/31/19
Roku, Inc.	\$100.00	\$189.57	\$369.86	\$222.15	\$304.42	\$521.64	\$218.84	460.71	646.87	726.72	956.19
Nasdaq Composite Index	\$100.00	\$100.66	\$107.25	\$110.03	\$117.30	\$126.00	\$104.21	121.72	126.43	126.66	142.44
Peer Group	\$100.00	\$101.01	\$107.32	\$106.80	\$123.54	\$118.94	\$98.33	116.98	120.78	119.52	134.14

Equity Compensation Plan Information

The following table summarizes information about our equity compensation plans as of December 31, 2019. All outstanding awards relate to our Class A common stock.

Plan Category	Number of securities to be issued upon exercise of outstanding options, warrants and rights	Weighted average exercise price of outstanding options, warrants and rights (1)	Number of securities remaining available for future issuances under equity compensation plans (excluding securities in column (a))
	(a)	(b) (in thousands, except per share amount)	(c)
Equity compensation plans approved by security holders (2)	15,668	\$ 14.84	19,039
Equity compensation plans not approved by security holders	—	—	—
Total	15,668	\$ 14.84	19,039

(1) Restricted stock units and warrants have been excluded for purposes of computing weighted average exercise prices in column (b) as they do not have an exercise price.

(2) The number of securities remaining available for future issuance in column (c) includes 16,950 shares of Class A common stock, available for issuance under our 2017 Equity Incentive Plan (the "2017 Plan") in column (a) and, includes 2,089 shares of Class A common stock available for issuance under our 2017 Employee Stock Purchase Plan. The number of shares authorized for issuance under the 2017 Plan are subject to an annual increase.

Item 6. Selected Financial Data

The selected consolidated financial data below should be read in conjunction with the Item 7, “Management’s Discussion and Analysis of Financial Condition and Results of Operations” and our consolidated financial statements and related notes included in Item 8, “Financial Statements and Supplementary Data,” of this Annual Report on Form 10-K.

The consolidated statements of operations data for the years ended December 31, 2019, 2018 and 2017, and the consolidated balance sheet data as of December 31, 2019 and 2018 are derived from our audited financial statements appearing in Item 8, “Financial Statements and Supplementary Data,” of this Annual Report on Form 10-K. The consolidated statement of operations data for the year ended December 31, 2016 and December 26, 2015 and the consolidated balance sheet data as of December 31, 2017, 2016 and December 26, 2015 are derived from audited financial statements not included in this Annual Report on Form 10-K. Our historical results are not necessarily indicative of the results that may be expected in any future period.

In 2017, the Company changed the fiscal year-end to match the calendar year-end. Prior to 2017, the Company’s fiscal year was the 52- or 53-week period that ended on the last Saturday of December. Fiscal year 2016 ended on December 31, 2016 and spanned 53 weeks.

	Years Ended December 31,				Year Ended December 26,
	2019 (1) (2)	2018 (1)	2017	2016	2015
	(in thousands, except per share data)				
Consolidated Statements of Operations Data:					
Total net revenue	\$ 1,128,921	\$ 742,506	\$ 512,763	\$ 398,649	\$ 319,857
Net loss attributable to common stockholders	\$ (59,937)	\$ (8,857)	\$ (63,509)	\$ (42,758)	\$ (40,611)
Net loss per share attributable to common stockholders— basic and diluted (3)	\$ (0.52)	\$ (0.08)	\$ (2.24)	\$ (9.01)	\$ (10.08)
Weighted-average shares used in computing net loss per share attributable to common stockholders—basic and diluted	115,218	104,618	28,308	4,746	4,030
Consolidated Balance Sheet Data:					
Total assets	\$ 1,470,234	\$ 464,997	\$ 371,897	\$ 179,078	\$ 176,511
Total long-term liabilities	\$ 413,507	\$ 26,342	\$ 56,360	\$ 43,217	\$ 46,593

- (1) We adopted the guidance in *Revenue from Contracts (Topic 606)* using the modified retrospective method effective January 1, 2018. Accordingly, the consolidated statement of operations for the years ended December 31, 2019 and 2018 reflect the impact of this adoption.
- (2) We adopted the guidance in *Leases (Topic 842)* using the optional transition method effective January 1, 2019. Accordingly, the consolidated statement of operations and consolidated balance sheet for the year ended December 31, 2019 reflects the impact of this adoption.
- (3) See Note 16 to the Consolidated Financial Statements in Item 8 for an explanation of the calculations of basic and diluted net loss per common share.

Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations

The following discussion and analysis of our financial condition and results of operations should be read in conjunction with the consolidated financial statements and related notes included elsewhere in this document. This discussion contains forward-looking statements that involve risks and uncertainties. Our actual results could differ materially from those discussed below. Factors that could cause or contribute to such differences include, but are not limited to, those identified below, and those discussed above in the section entitled "Risk Factors." Our fiscal year ends on December 31.

Overview

Roku is the leading TV streaming platform in the United States based on hours streamed. We pioneered streaming to the TV and were founded on the belief that someday all TV content would be streamed. Over the last year as TV streaming has become mainstream, many of the biggest names in media and TV programming embraced the transition to streaming resulting in the launch of new TV streaming services, growing investment in original content that is exclusive to streaming, and more ad-supported TV viewing options. We are capitalizing on this economic opportunity by connecting our users to the streaming content they love, enabling content publishers to build and monetize large audiences, and providing advertisers with unique capabilities to reach and engage consumers. As of December 31, 2019, we had 36.9 million active accounts, an increase of 36% from the prior year, and our users streamed 40.3 billion hours of content during 2019, an increase of 68% year-over-year.

Our business model is driven by three core activities. We focus on increasing the number of active accounts on our streaming platform, increasing user engagement and growing the hours of content streamed, and growing our revenue and gross profit by monetizing user activity on our platform. To increase the number of active accounts on our platform, we sell stand-alone streaming devices, we partner with TV brand partners who license the Roku OS to manufacture and sell Roku TV models, and we also license the Roku OS to certain service operators. During 2019, the fastest growing source of new accounts was licensing arrangements with our Roku TV brand partners and other service operators, which collectively accounted for 56% of new accounts, up from 50% in 2018.

We operate in two revenue segments: the platform segment and the player segment. We generate platform revenue from the sale of digital advertising and related services, content distribution services, subscription and transaction revenue shares, Premium Subscriptions, billing services, sale of branded channel buttons on remote controls and licensing arrangements with service operators and TV brands. We measure our platform monetization through average revenue per user ("ARPU"), which we believe represents the inherent value of our business. We generated revenue of \$1,128.9 million during the year ended December 31, 2019, up by 52% year-over-year. During the year ended December 31, 2019, we generated a gross profit of \$495.2 million, which is up 49% from the year ended December 31, 2018. We believe we have a significant opportunity to continue to grow platform revenue, and, as we further monetize streaming hours, we believe we will increase ARPU. ARPU was \$23.14 for the year ended December 31, 2019 as compared to \$17.95 for the year ended December 31, 2018, an increase of 29%.

Player revenue is generated primarily from the sale of streaming players. We expect we will continue to manage the average selling prices ("ASP") of our streaming players to increase our active accounts. As a result, player revenues may not increase as they have historically. We expect that the tradeoff from player gross profit to grow active accounts will result in increased platform monetization and gross profit.

Key Performance Metrics

The key performance metrics we use to evaluate our business, measure our performance, develop financial forecasts and make strategic decisions are gross profit, active accounts, streaming hours, and ARPU.

Gross Profit

We use gross profit as the primary metric to measure the performance of our business because we have two revenue segments that have different margin profiles, and we aim to maximize our higher margin platform revenue from our active accounts as they stream content on our platform. The majority of our gross profit is generated from our platform segment.

Our gross profit was \$495.2 million and \$332.1 million for the years ended December 31, 2019 and 2018, respectively.

Active Accounts

We believe that the number of active accounts is a relevant measure to gauge the size of our user base. We define active accounts as the number of distinct user accounts that have streamed content on our platform within the last 30 days of the period. Users who streamed content from The Roku Channel only on non-Roku platforms are not included in this metric. The number of active accounts also does not correspond to the number of unique individuals who actively utilize our platform, or the number of devices associated with an account. For example, a single account may be used by more than one individual, such as a family, and one account may be used on multiple streaming devices.

We had 36.9 million and 27.1 million active accounts as of December 31, 2019 and 2018, respectively.

Streaming Hours

We believe the number of streaming hours on our platform is an effective measure of user engagement and that the growth in the number of hours of content streamed across our platform reflects our success in addressing the growing user demand for TV streaming. We define streaming hours as the aggregate amount of time streaming devices stream content on our platform in a given period. Hours streamed on non-Roku platforms are not included in this metric. We report streaming hours on a calendar basis.

Additionally, we believe that over time, increasing user engagement on our streaming platform increases our platform monetization because we earn platform revenue from advertising as well as from revenue shares from subscriptions and transactional video on-demand. However, our revenue from content publishers is not tied to the hours streamed on their streaming channels, and the number of streaming hours does not correlate to revenue earned from such content publishers or ARPU on a period-by-period basis. Moreover, streaming hours on our platform are measured whenever a Roku player or a Roku TV is streaming content, whether a viewer is actively watching or not. For example, if a Roku player is connected to a TV, and the viewer turns off the TV, steps away or falls asleep and does not stop or pause the player, then the particular streaming channel may auto-play subsequent content for a period of time determined by the streaming channel. We believe that this also occurs across a wide variety of non-Roku streaming devices and other set-top boxes.

During the third quarter of 2019, we began rolling out a new Roku OS feature that is designed to identify when content has been continuously streaming on a channel for an extended period of time without user interaction. This feature, which we refer to as “Are you still watching,” periodically prompts the user to confirm that they are still watching the selected channel and closes the channel if the user does not respond affirmatively. We believe that implementing this new feature across the Roku platform will benefit us, our customers, channel partners and advertisers. Some of our leading channel partners, including Netflix, have already implemented similar features within their channels. “Are you still watching” supplements these channel features. We began rolling out to our entire installed base during 2019 and completed the rollout in the first quarter of 2020. While we expect continued robust growth in our aggregate streaming hours as we grow active accounts and user engagement, we believe our year-over-year growth rates of streaming hours reported in 2020 are likely to be lower than the year-over-year growth rates we reported in 2019. We do not expect the rollout of this feature to have a material impact on our future financial performance.

We streamed 40.3 billion and 24.0 billion hours during the years ended December 31, 2019 and 2018, respectively.

Average Revenue per User

We measure our platform monetization progress with ARPU. We define ARPU as our platform revenue for the trailing four quarters divided by the average of the number of active accounts at the end of the current period and the end of the corresponding period in the prior year. ARPU measures the rate at which we are monetizing our active account base and the progress of our platform business.

Our average revenue per user was \$23.14 and \$17.95 as of December 31, 2019 and 2018, respectively.

Factors Affecting Our Performance

Rate of TV streaming and advertising shift to OTT

Consumers have significantly shifted their TV viewing behavior, and we believe that someday all TV content will be streamed. We also believe this presents a large market opportunity for digital advertising. This shift in viewing behavior is a critical component of our business model because our platform revenue and player revenue, as well as our overall expense structure, is dependent on this shift. In addition, the number of hours streamed on our platform is a critical element of our business because hours determine our advertising inventory and sell through.

User acquisition strategy

We acquire users through three primary ways: we sell streaming players, we partner with TV brands through our Roku TV licensing program, and we have licensing relationships with service operators. We monetize our user base through platform revenue. Player revenue and player gross profit may decrease over time as we strategically aim to acquire new users through the sale of lower priced streaming players.

Ability to monetize users and streaming hours

Our business model is to increase the number of active accounts and related streaming hours and grow revenue and gross profit through the monetization of our streaming platform. We believe we have a significant opportunity to grow platform revenue as we further monetize our users' engagement. Our platform makes it easy for content publishers to distribute and monetize their streaming content through three primary business models: transaction video on demand ("TVOD") that includes channels that offer a la carte movie purchases or rentals, subscription video on demand ("SVOD") that includes subscriptions to individual video on demand channels and so-called virtual multichannel video programming distribution services, and advertising supported video on demand ("AVOD") that includes channels that do not charge a subscription fee to users. We generate revenue from TVOD and SVOD channels from various forms of revenue sharing arrangements. Our revenue sharing arrangements generally apply to new subscriptions for accounts that sign up for new services and to movie rentals or purchases for TVOD. Through our platform we also are able to offer content partners with billing services which support in-channel purchases including movie purchases, rentals, and subscriptions.

Revenue from the distribution of AVOD channels is generated through the sale of advertising within the channel. AVOD is our fastest growing area of business, and we are increasing the monetization of these streaming hours by expanding our advertising capabilities both on and off our platform. We intend to continue to leverage our data and analytics to deliver relevant advertising and improve the ability of our advertisers to optimize their campaigns and measure their results. We also plan to continue to expand our direct sales teams to increase the number of advertisers who use our services. In late 2017, we launched The Roku Channel, which offers ad-supported free access for users to a collection of films, television series and other content, and at the same time we began a fundamental transition to increase digital advertising inventory under our control and to create another way of connecting content publishers with users. The Roku Channel has grown from providing customers with free access to 1,000 movies and TV episodes, initially, to over 10,000 hit Hollywood movies, TV shows, news and more and is rapidly becoming one of our leading sources of advertising inventory. In January 2019, we launched Premium Subscriptions within The Roku Channel, through which we resell ad-free premium content subscription services from providers such as Showtime, Starz, HBO and Epix.

Continued investment in growth

We believe that our future performance will depend on the success of the investments we have made, and will continue to make, to improve the value for users, content publishers and advertisers on our platform. We must regularly update and enrich our platform to meet evolving consumer behavior and deliver a superior experience for our users, content publishers and advertisers. Further, it is important that we remain a frictionless platform for content delivery and invest to provide content publishers with best-in-class publishing tools and actionable audience insights. We must continue to innovate and invest in our advertising capabilities and technology so that we attract and encourage incremental advertising spend on our platform.

Seasonality

In the fourth quarter of each calendar year, we generally generate significantly higher levels of revenue and gross profit from platform revenue and significantly higher levels of player revenue. For the years ended December 31, 2019 and 2018, fourth quarter revenue comprised 36% and 37% of our total net revenue, respectively, and fourth quarter gross profit comprised 33% and 34% of our total gross profit, respectively.

Components of Results of Operations**Revenue****Platform Revenue**

We generate platform revenue from the sale of digital advertising and related services, content distribution services, subscription and transaction revenue shares, Premium Subscriptions, billing services, sale of branded channel buttons on remote controls and licensing arrangements with service operators and TV brands. Our first-party digital ad inventory includes The Roku Channel, native display ads on our home screen and screen saver as well as ad inventory we obtain through our content publisher agreements. To supplement our supply, we can re-sell video inventory that we purchase from content publishers and, to a lesser extent, directly sell third-party inventory on a revenue share basis. To date, we generate most of our platform revenue in the United States.

Player Revenue

We generate player revenue primarily from the sale of streaming players through consumer retail distribution channels, including major brick and mortar retailers, such as Best Buy and Walmart, and online retailers, primarily Amazon. We generate most of our player revenue in the United States. In our international markets, we sell our players through wholesale distributors which, in turn, re-sell to retailers. We currently distribute our players in Canada, the United Kingdom, France, the Republic of Ireland, Mexico and several other Latin American countries.

To enhance user experience, we introduced wireless speakers in 2018 that work with Roku TV models and introduced the Roku Smart Soundbar and the Roku Wireless Subwoofer in September 2019.

Cost of Revenue**Cost of Platform Revenue**

Cost of platform revenue consists of advertising inventory acquisition costs, payment processing fees, third-party cloud service fees, content licensing fees and allocated personnel-related costs, including salaries, benefits and stock-based compensation for our personnel who support platform services.

Cost of Player Revenue

Cost of player revenue is comprised of player manufacturing costs payable to our third-party contract manufacturers, technology licenses or royalty fees, inbound and outbound freight, duty and logistics costs, third-party packaging and assembly costs, provision for excess or obsolete inventory, allocated overhead costs related to facilities and customer support, and salary, benefits and stock-based compensation costs for operations personnel.

Operating and Other Expenses**Research and Development**

Research and development expenses consist primarily of personnel-related costs, including employee salaries, benefits and stock-based compensation for our engineers and other employees engaged in the development of our products including new player and platform technologies, features and functionality and fees for outsourced consulting services. In addition, research and development expenses include allocated facilities and overhead costs. We believe continued investment is important to attaining our strategic objectives.

Sales and Marketing

Sales and marketing expenses consist primarily of personnel-related costs, including salaries, benefits, commissions and stock-based compensation expense for our employees engaged in sales and sales support, marketing, communications, data science and analytics, business development, product management and partner and customer support functions. Sales and marketing expenses also include marketing, retail and merchandising costs, as well as events, public relations and other professional services and allocated facilities and overhead.

General and Administrative

General and administrative expenses consist primarily of personnel-related costs, including salaries, benefits and stock-based compensation for our executive, finance, legal, information technology, human resources and other administrative personnel. We expect our general and administrative expenses to increase due to the anticipated growth of our business and related infrastructure, compliance with global laws and regulations, as well as accounting, legal, insurance, investor relations and other costs associated with being a public company.

Other Income (Expense), Net

Our other income (expense), net, for the years ended December 31, 2019 and 2018, consists of interest income on short-term investments and cash balances, interest expense that primarily includes amortization of deferred debt costs and foreign currency re-measurement and transaction gains and losses. Other income (expense), net, for the year ended December 31, 2017 consisted of changes in the fair value of our convertible preferred stock warrant liability, interest expense on our debt, and foreign currency re-measurement and transaction gains and losses. Prior to our IPO, the underlying shares of our convertible preferred stock warrants were contingently redeemable, and we accounted for these warrants as a liability at fair value and re-measured the fair value at each balance sheet date. As a result of our IPO, the convertible preferred stock warrant liability was reclassified to stockholders' equity and re-measurement was no longer required.

Income Tax Expense

Our income tax expense consists primarily of income taxes in certain foreign jurisdictions where we conduct business and state minimum income taxes in the United States. We have a valuation allowance for U.S. deferred tax assets, including net operating loss carryforwards and tax credits related primarily to research and development. We expect to maintain this valuation allowance for the foreseeable future.

Results of Operations

The following table sets forth selected consolidated statements of operations data as a percentage of total revenue for each of the periods indicated.

	Years Ended December 31,		
	2019	2018	2017
Net Revenue:			
Platform	66%	56%	44%
Player	34%	44%	56%
Total net revenue	100%	100%	100%
Cost of Revenue:			
Platform	23%	16%	11%
Player	33%	39%	50%
Total cost of revenue	56%	55%	61%
Gross Profit:			
Platform	43%	40%	33%
Player	1%	5%	6%
Total gross profit	44%	45%	39%
Operating Expenses:			
Research and development	24%	23%	21%
Sales and marketing	16%	14%	13%
General and administrative	10%	10%	9%
Total operating expenses	50%	47%	43%
Loss from Operations	(6)%	(2)%	(4)%
Other Income (Expense), Net:			
Interest expense	—%	—%	—%
Loss on extinguishment of debt	—%	—%	(1)%
Change in fair value of preferred stock warrant liability	—%	—%	(8)%
Other income (expense), net	1%	1%	—%
Total other income (expense), net	1%	1%	(9)%
Loss before income taxes	(5)%	(1)%	(13)%
Income tax (benefit) expense	—%	—%	—%
Net loss attributable to common stockholders	(5)%	(1)%	(13)%

Comparison of Years Ended December 31, 2019 and 2018**Net Revenue**

	Years Ended December 31,		Change \$	Change %
	2019	2018		
(in thousands, except percentages)				
Platform	\$ 740,776	\$ 416,863	\$ 323,913	78%
Player	388,145	325,643	62,502	19%
Total Net Revenue	<u>\$ 1,128,921</u>	<u>\$ 742,506</u>	<u>\$ 386,415</u>	52%

Platform

Platform revenue increased by \$323.9 million, or 78%, for the year ended December 31, 2019 as compared to the year ended December 31, 2018. In addition to an increase in content distribution revenue, the majority of the increase is from higher advertising revenue. The increase was partially offset by a decrease of \$7.7 million in licensing revenue which resulted from delivery of intellectual property that was lower in 2019 as compared to 2018.

Player

Player revenue increased by \$62.5 million, or 19%, for the year ended December 31, 2019 as compared to the year ended December 31, 2018. During the year ended December 31, 2019, the volume of players sold increased 29% as compared to the year ended December 31, 2018 offset by a 9% decrease in the average selling price of players. Revenue generated from the sale of audio products is included in player revenue and is not significant.

Cost of Revenue

	Years Ended December 31,		Change \$	Change %
	2019	2018		
(in thousands, except percentages)				
Cost of revenue:				
Platform	\$ 262,655	\$ 120,543	\$ 142,112	118%
Player	371,042	289,815	81,227	28%
Total Cost of Revenue	<u>\$ 633,697</u>	<u>\$ 410,358</u>	<u>\$ 223,339</u>	54%
Gross profit:				
Platform	\$ 478,121	\$ 296,320	\$ 181,801	61%
Player	17,103	35,828	(18,725)	(52)%
Total Gross Profit	<u>\$ 495,224</u>	<u>\$ 332,148</u>	<u>\$ 163,076</u>	49%

Platform

The cost of platform revenue increased by \$142.1 million, or 118%, for the year ended December 31, 2019 as compared to the year ended December 31, 2018. This increase is a result of higher advertising inventory acquisition costs, ad serving costs, content licensing fees and credit card processing fees totaling \$133.4 million as well as an \$8.9 million increase in allocated overhead primarily in advertising operations and content distribution operations driven by the growth of the platform business.

Gross profit for platform revenue increased by \$181.8 million, or 61%, for the year ended December 31, 2019 as compared to the year ended December 31, 2018, primarily driven by growth in our platform revenues.

Player

The cost of player revenue increased by \$81.2 million, or 28%, for the year ended December 31, 2019 as compared to the year ended December 31, 2018. The cost of player revenue increased approximately \$49.3 million due to an increase in manufacturing costs to support a higher volume of players sold. In addition, royalty expenses increased \$21.7 million driven by increased volume of sales and approximately \$9.3 million of royalties accrued for

intellectual property claims. The increase in royalty expenses also includes the impact of the release of an accrual of \$8.9 million in the second quarter of 2018 pursuant to a potential intellectual property liability that did not materialize or reoccur in fiscal 2019. Additionally, freight costs increased by \$3.2 million to support higher volume.

Gross profit for player revenue decreased by \$18.7 million, or 52%, for the year ended December 31, 2019 as compared to the year ended December 31, 2018, primarily due to the impact of royalty accruals and releases as noted above, and the decrease in the average selling prices of players and increase in manufacturing and logistics costs.

Operating Expenses

	Years Ended December 31,		Change \$	Change %
	2019	2018		
(In thousands, except percentages)				
Research and development	\$ 265,011	\$ 170,692	\$ 94,319	55%
Sales and marketing	178,855	102,780	76,075	74%
General and administrative	116,417	71,972	44,445	62%
Total Operating Expenses	<u>\$ 560,283</u>	<u>\$ 345,444</u>	<u>\$ 214,839</u>	62%

Research and development

Research and development expenses increased by \$94.3 million, or 55%, for the year ended December 31, 2019 as compared to the year ended December 31, 2018. The increase was primarily due to higher personnel-related costs of \$68.8 million as a result of increased engineering headcount of 37% and related stock-based compensation, higher facilities costs of \$14.7 million and higher platform and product development costs of \$10.8 million. These platform and product development costs include expenses such as consulting and outside services, as well as travel and equipment, which are partially offset by allocation of overhead to player and platform costs.

Sales and marketing

Sales and marketing expenses increased by \$76.1 million, or 74%, for the year ended December 31, 2019 as compared to the year ended December 31, 2018. The increase was primarily due to higher personnel-related costs of \$38.2 million related to increased headcount of 82% and related stock-based compensation to support our growth in platform revenue, mainly in advertising and content distribution. Other sales and marketing expenses include an increase of \$19.5 million in marketing, retail and merchandising costs, higher facilities costs of \$11.0 million and an increase in other expenses of \$7.3 million that includes consulting services and travel.

General and administrative

General and administrative expenses increased by \$44.4 million, or 62%, for the year ended December 31, 2019 as compared to the year ended December 31, 2018. The increase was primarily due to higher personnel-related costs of \$23.6 million as a result of increased headcount in general and administrative functions of 46% including stock-based compensation expense and \$19.0 million primarily related to increased legal and other outside consulting and professional service fees.

Other Income (Expenses), Net

	Years Ended December 31,		Change \$	Change %
	2019	2018		
(In thousands, except percentages)				
Interest expense	\$ (2,366)	\$ (346)	\$ (2,020)	584%
Other income (expense), net	6,506	4,309	2,197	51%
Total Other Income (Expense), Net	<u>\$ 4,140</u>	<u>\$ 3,963</u>	<u>\$ 177</u>	4%

Other income (expenses), net

Other income (expense), net, increased by \$0.2 million during the year ended December 31, 2019 as compared to the year ended December 31, 2018, primarily due to an increase in interest expense relating to amortization of deferred debt costs and interest expense related to the Credit Facility, offset by an increase in interest income from short-term investments and a higher level of cash balances.

Income Tax Benefit

(in thousands, except percentages)	Years Ended December 31,		Change \$	Change %
	2019	2018		
Income Tax Benefit	\$ (982)	\$ (476)	\$ (506)	106%

Income tax benefit

Income tax benefit arises from foreign income taxes and state minimum income taxes in the United States.

Comparison of years ended December 31, 2018 and 2017**Net Revenue**

(in thousands, except percentages)	Years Ended December 31,		Change \$	Change %
	2018	2017		
Platform	\$ 416,863	\$ 225,356	\$ 191,507	85%
Player	325,643	287,407	38,236	13%
Total Net Revenue	<u>\$ 742,506</u>	<u>\$ 512,763</u>	<u>\$ 229,743</u>	45%

Platform

Platform revenue increased by \$191.5 million, or 85%, for the year ended December 31, 2018 as compared to the year ended December 31, 2017 and is inclusive of \$25.2 million recognized as a result of the adoption of ASC 606. The increase includes \$170.6 million from increases in advertising, subscription and transaction revenue share and the number of paid subscriptions. The revenues from licensing arrangements with service operators and TV brands increased by \$21.2 million mainly driven by the delivery of intellectual property to a licensing partner during the first quarter of 2018.

Player

Player revenue increased by \$38.2 million, or 13%, for the year ended December 31, 2018 as compared to the year ended December 31, 2017. The increase in player revenue was mainly a result of an increase in the volume of players sold mitigated by a reduction in the average selling price of the players. An increase of 19% in the volume of players sold, consisting mainly of our lower priced players, resulted in a 6% decrease in the average selling price of the players. Audio products launched towards the end of the year are included in player revenues and contributed insignificant revenues.

Cost of Revenue

	Years Ended December 31,			
	2018	2017	Change \$	Change %
(in thousands, except percentages)				
Cost of revenue:				
Platform	\$ 120,543	\$ 54,826	\$ 65,717	120%
Player	289,815	258,104	31,711	12%
Total Cost of Revenue	<u>\$ 410,358</u>	<u>\$ 312,930</u>	<u>\$ 97,428</u>	31%
Gross profit:				
Platform	\$ 296,320	\$ 170,530	\$ 125,790	74%
Player	35,828	29,303	6,525	22%
Total Gross Profit	<u>\$ 332,148</u>	<u>\$ 199,833</u>	<u>\$ 132,315</u>	66%

Platform

The cost of platform revenue increased by \$65.7 million, or 120%, for the year ended December 31, 2018 as compared to the year ended December 31, 2017. Advertising inventory acquisition costs, ad serving costs, content acquisition fees and credit card processing fees increased by \$55.2 million and allocated overhead increased by \$9.4 million during the year ended December 31, 2018. The increase is driven by the growth of our platform business which attracts additional advertisements and monetization opportunities.

Gross profit for platform revenue increased by \$125.8 million, or 74%, for the year ended December 31, 2018 as compared to the year ended December 31, 2017, primarily driven by growth in our platform revenues. The increase includes \$10.1 million recognized as a result of the adoption of ASC 606.

Player

The cost of player revenue increased by \$31.7 million, or 12%, for the year ended December 31, 2018 as compared to the year ended December 31, 2017. The increase in cost of player revenue was primarily the result of approximately \$44.0 million in increased manufacturing and related costs to support the increased volume of players sold, offset by the release of accruals related to IP licensing obligations that did not materialize and management now believes will not materialize in the amount of approximately \$8.9 million and a reduction in freight costs of \$4.6 million. The reduction in freight cost is due to higher costs incurred in the year ended December 31, 2017 to expedite inbound supply to minimize the effect of supply disruption, which did not reoccur in the year ended December 31, 2018.

Gross profit for player revenue increased by \$6.5 million, or 22%, for the year ended December 31, 2018 as compared to the year ended December 31, 2017 primarily due to the release of accruals related to unrealized IP licensing obligations during the second quarter of 2018 and reduced freight costs.

Operating Expenses

	Years Ended December 31,			
	2018	2017	Change \$	Change %
(in thousands, except percentages)				
Research and development	\$ 170,692	\$ 107,945	\$ 62,747	58%
Sales and marketing	102,780	64,069	38,711	60%
General and administrative	71,972	47,435	24,537	52%
Total Operating Expenses	\$ 345,444	\$ 219,449	\$ 125,995	57%

Research and development

Research and development expenses increased by \$62.7 million, or 58%, for the year ended December 31, 2018 as compared to the year ended December 31, 2017. The increase was primarily due to higher personnel-related costs of \$51.1 million as a result of increased engineering headcount of 36%, higher facilities costs of \$4.1 million and higher platform and product development costs of \$7.6 million that includes expenses such as consulting and outside services, travel and equipment, offset by allocation of overheads.

Sales and marketing

Sales and marketing expenses increased by \$38.7 million, or 60%, for the year ended December 31, 2018 as compared to the year ended December 31, 2017. The increase was primarily due to higher personnel-related costs of \$29.8 million related to increased headcount of 43%, higher facilities costs of \$3.3 million, increases in consulting expenses of \$2.2 million and higher travel and entertainment expenses of \$1.3 million.

General and administrative

General and administrative expenses increased by \$24.5 million, or 52%, for the year ended December 31, 2018 as compared to the year ended December 31, 2017. The increase was primarily due to higher personnel-related costs of \$14.6 million as a result of increased headcount in general and administrative functions of 26%, an increase in consulting and professional service fees of \$9.7 million related to increased accounting and legal services and an increase of \$2.1 million in facilities costs.

Other Income (Expenses), Net

	Years Ended December 31,		Change \$	Change %
	2018	2017		
(in thousands, except percentages)				
Interest expense	\$ (346)	\$ (1,612)	\$ 1,266	(79)%
Loss on extinguishment of debt	—	(2,338)	2,338	(100)%
Change in fair value of convertible preferred stock warrants	—	(40,333)	40,333	(100)%
Other income, net	4,309	705	3,604	511%
Total Other Income (Expense), Net	<u>\$ 3,963</u>	<u>\$ (43,578)</u>	<u>\$ 47,541</u>	<u>(109)%</u>

Other income (expense), net, changed by \$47.5 million during the year ended December 31, 2018 as compared to the year ended December 31, 2017 primarily due to a charge of \$40.3 million that was recorded during the year ended December 31, 2017 related to the change in the fair value of warrants to purchase convertible preferred stock. No such charge was required during the year ended December 31, 2018 as warrants to purchase convertible preferred stock were converted into warrants to purchase common stock upon our IPO. Other income (expense), net, increased by \$3.6 million during the year ended December 31, 2018 as compared to the year ended December 31, 2017 due to an increase in interest income from a higher cash balance, short-term investments earned in the second half of the year and a one-time cancellation and restocking fee of \$1.4 million from a customer. Interest expense for the year ended December 31, 2017 was higher by \$1.3 million due to outstanding debt during that period. No such debt was outstanding in 2018.

Income Tax (Benefit) Expense

	Years Ended December 31,		Change \$	Change %
	2018	2017		
(in thousands, except percentages)				
Income Tax (Benefit) Expense	\$ (476)	\$ 315	\$ (791)	(251)%

Income tax (benefit) expense is comprised of foreign income tax and state minimum income taxes in the United States.

Liquidity and Capital Resources

As of December 31, 2019, we had cash and cash equivalents of \$515.5 million. Our primary source of liquidity is cash generated through operating and financing activities, including sales of our Class A common stock and our capacity to borrow under the Credit Agreement. Our primary uses of cash include operating expenses such as personnel-related expenses, consultants and professional services, and investments in capital spending. Our future capital requirements may vary materially from those currently planned and will depend on many factors including our growth rate and the continuing market acceptance of our advertising platform, operating system and technology and players along with the timing and effort related to the introduction of new platform features, players, hiring of experienced personnel, the expansion of sales and marketing activities, as well as overall economic conditions. We entered into lease agreements for new corporate headquarters, as well as other office locations. We have incurred material expenses in 2019 and expect to continue to incur material expenses in future years for facility and related building costs. We completed the acquisition of dataxu, Inc. in November 2019 for a total purchase consideration of \$148.4 million, which consisted of \$78.7 million in cash and \$69.7 million for the fair value of our 571,459 shares of common stock. We may contemplate additional merger and acquisition activity that could materially impact our liquidity and capital resource position. However, we believe that our existing cash balances and cash flow from operations, together with amounts available under our Credit Agreement, will be sufficient to fund our working capital and meet our anticipated cash needs for the foreseeable future.

As of December 31, 2019, approximately 1.4% of our cash was held outside the United States. These amounts were primarily held in Europe and are utilized to fund our foreign operations. The amount of unremitted earnings related to our foreign subsidiaries is not material.

At-the-Market Offerings

On March 12, 2019, we entered into an Equity Distribution Agreement with Citigroup Global Markets Inc., as our sales agent (the "Citi Equity Distribution Agreement"), pursuant to which we could issue and sell from time-to-time shares of our Class A common stock for aggregate gross proceeds of up to \$100.0 million. In March 2019, we sold approximately 1.4 million shares of Class A common stock at an average selling price of \$72.00 per share, constituting all available shares for sale under the Citi Equity Distribution Agreement, for aggregate gross proceeds of \$100.0 million and incurred issuance costs of \$2.0 million.

On May 16, 2019, we entered into an Equity Distribution Agreement with Morgan Stanley & Co. LLC, as our sales agent (the "MS Equity Distribution Agreement"), pursuant to which we could issue and sell up to 1.0 million shares of our Class A common stock. In May 2019, we sold all 1.0 million available shares for sale under the MS Equity Distribution Agreement at an average selling price of \$82.90 per share, for aggregate gross proceeds of \$82.9 million and incurred issuance costs of \$1.6 million.

On November 19, 2019, we entered into and Equity Distribution Agreement with Citigroup Global Markets Inc. as our sales agent (the "Citi Equity Distribution Agreement – 2"), pursuant to which we could issue and sell from time-to-time up to an aggregate of 1.0 million shares of our Class A common stock. In November 2019, we sold all 1.0 million shares available for sale under the Citi Equity Distribution Agreement – 2 at an average selling price of \$153.99 per share for aggregate gross proceeds of \$153.99 million and incurred issuance cost of \$2.8 million.

Senior Secured Term Loan A and Revolving Credit Facilities

On February 19, 2019 (the "Original Closing Date"), we entered into a Credit Agreement (the "Existing Credit Agreement") with Morgan Stanley Senior Funding, Inc. ("MSSF"). On May 3, 2019, (the "Closing Date"), the Existing Credit Agreement was amended pursuant to an Incremental Assumption and Amendment No. 1 (the "Amendment" and the Existing Credit Agreement as amended by the Amendment, the "Credit Agreement"). On the Original Closing Date, we terminated the Restated 2014 LSA (as defined below) with Silicon Valley Bank.

The Credit Agreement provides for (i) a four-year revolving credit facility in the aggregate principal amount of up to \$100.0 million (the "Revolving Credit Facility"), (ii) a four-year delayed draw term loan A facility in the aggregate principal amount of up to \$100.0 million (the "Term Loan A Facility") and (iii) an uncommitted

incremental facility, subject to the satisfaction of certain financial and other conditions, in the amount of up to (v) \$50.0 million, plus (w) 1.0x of our consolidated EBITDA for the most recently completed four fiscal quarter period, plus (x) an additional amount at our discretion, so long as, on a pro forma basis at the time of incurrence, our secured leverage ratio does not exceed 1.50 to 1.00, plus (y) voluntary prepayments of the Revolving Credit Facility and Term Loan A Facility to the extent accompanied by concurrent reductions to the applicable Credit Facility (together with the Revolving Credit Facility and the Term Loan A Facility, collectively, the "Credit Facility").

On November 18, 2019, we borrowed from the Term Loan A facility in the aggregate principal amount of \$100.0 million and elected a Eurodollar borrowing with interest at a rate equal to the adjusted one-month LIBOR rate plus an applicable margin of 1.75% based on our secured leverage ratio.

Loans under the Term Loan A Facility will amortize in equal quarterly installments beginning March 31, 2020, in an aggregate annual amount equal to (i) on or prior to December 31, 2021, 1.25% of the drawn principal amount of the Term Loan Facility or \$1.25 million and (ii) thereafter, 2.50% of the drawn principal amount of the Term Loan Facility or \$2.5 million, with the remaining balance payable on the maturity date of the Term Loan A Facility.

We did not have any borrowings outstanding on the Revolving Credit Facility as of December 31, 2019. We had outstanding letters of credit as of December 31, 2019, which reduced the balance available to draw on the Revolving Credit Facility to \$69.3 million.

Our obligations under the Credit Agreement are secured by substantially all of our assets. In the future, certain of our direct and indirect subsidiaries may be required to guarantee the Credit Agreement. We may prepay, and in circumstances are required to prepay, loans under the Credit Agreement without payment of a premium. The Credit Agreement contains customary representations and warranties, customary affirmative and negative covenants, a financial covenant that is tested quarterly and requires us to maintain a certain adjusted quick ratio of at least 1.00 to 1.00, and customary events of default.

As of December 31, 2019, we were in compliance with all the covenants of the Credit Agreement.

Cash Flows

The following table summarizes our cash flows for the periods presented (in thousands):

	Years Ended December 31,		
	2019	2018	2017
Consolidated Statements of Cash Flows Data:			
Cash flows provided by operating activities	\$ 13,707	\$ 13,922	\$ 37,292
Cash flows used in investing activities	(110,295)	(60,133)	(12,268)
Cash flows provided by financing activities	458,328	24,525	117,664

Cash Flows from Operating Activities

Our operating activities provided cash of \$13.7 million for the year ended December 31, 2019. Our net loss of \$59.9 million for the year ended December 31, 2019 was adjusted by non-cash charges of \$102.7 million comprising mainly of \$85.2 million of stock-based compensation and \$15.7 million of depreciation and amortization primarily on property and equipment. The changes in our operating assets and liabilities used cash of \$29.0 million comprised of outflows of \$110.2 million from an increase in accounts receivable due to increased seasonal revenues in the fourth quarter, \$14.1 million from increasing inventory levels, \$10.6 million from a decrease in deferred revenue, \$11.6 million from an increase in prepaid and other current assets due to an increase in prepaid contracts, marketing expenses and prepaid capital expenditure for new facilities, \$3.0 million from a decrease in other long-term liabilities, and \$3.0 million from an increase in other long term assets. These outflows were offset by cash inflows of \$79.1 million from an increase in accrued liabilities due to timing of payments, increased content publishers payables, and overall growth in the volume of business, \$22.3 million from amortization of operating lease right-of-use assets, \$11.7 million from an increase in operating lease liabilities, \$9.4 million from an increase in accounts payable, and \$1.1 million from a decrease in deferred cost of revenue.

Our operating activities generated \$13.9 million in cash for the year ended December 31, 2018. Our net loss of \$8.9 million for the year ended December 31, 2018 was adjusted by non-cash charges of \$48.4 million comprising mainly of \$8.4 million of depreciation and amortization, \$37.7 million of stock-based compensation, \$1.1 million relating to loss incurred on exiting facilities and \$0.9 million of provision related to doubtful accounts. The changes in our operating assets and liabilities used cash of \$25.6 million comprising of outflows of \$50.7 million from an increase in accounts receivable due to increased seasonal revenues in the fourth quarter, \$3.0 million from increasing inventory levels and \$1.1 million from a decrease in other long-term liabilities. These outflows were offset by cash inflows of \$17.9 million from an increase in accrued liabilities, \$10.1 million from an increase in deferred revenue and \$2.3 million from a decrease in deferred cost of revenue.

During the year ended December 31, 2017, operating activities generated \$37.3 million in cash as a result of net loss of \$63.5 million, adjusted by non-cash charges of \$60.4 million and an increase of \$39.5 million in our net operating assets and liabilities. The non-cash charges comprise mainly of \$40.3 million of change in fair value of preferred stock warrants, \$11.0 million of stock-based compensation, \$5.3 million of depreciation and amortization, \$2.3 million of loss from extinguishment of debt and \$0.5 million of loss relating to exit from our prior headquarter facilities. The increase in operating assets and liabilities was the result of an increase in accounts payable and accrued liabilities of \$48.4 million due to both the growth in business and the timing of payments, an increase in deferred revenue balances of \$30.0 million, a decrease in inventories of \$10.8 million, and an increase in other long-term liabilities by \$3.6 million. These increases were offset by an increase in accounts receivable of \$41.2 million as a result of growth in our business, an increase in prepaid and other current assets of \$6.5 million and an increase in other non-current assets of \$2.8 million.

Cash Flow from Investing Activities

Our investing activities for the year ended December 31, 2019 included a cash outflow of \$77.2 million for the purchase of property and equipment, including expenditures on leasehold improvements related to expanding our facilities, and other capital investments, \$68.1 million related to the acquisition of dataxu, Inc., \$12.4 million spent on the purchase of short-term investments, and \$7.4 million related to the purchases of other intangible assets, partially offset by \$54.8 million received from sales/maturities of short-term investments.

Our investing activities for the year ended December 31, 2018 included cash outflow of \$18.3 million spent on the purchase of property and equipment, including expenditure on leasehold improvements related to expanding our facilities, and other capital investments and \$53.8 million spent on the purchase of short-term investments, partially offset by \$12.0 million received from sales/maturities of short-term investments.

During the year ended December 31, 2017, investing activities used \$12.3 million in cash mainly on capital expenditures related to the purchase of property, equipment and leasehold improvements of \$9.2 million and acquisition of a business of \$3.0 million.

Cash Flow from Financing Activities

Our financing activities provided cash of \$458.3 million for the year ended December 31, 2019. The cash was received mainly from net proceeds from the issuance of common stock through our at-the-market programs amounting to \$330.5 million, net of offering costs, proceeds from borrowings amounting to \$99.6 million, net of issuance costs, and proceeds from the exercise of employee stock options of \$28.2 million.

Our financing activities provided cash of \$24.5 million for the year ended December 31, 2018. The cash was generated mainly from the exercise of employee stock options amounting to \$25.0 million partially offset by a payment of \$0.5 million in connection with a previous business acquisition.

During the year ended December 31, 2017, financing activities provided \$117.7 million in cash primarily from the sale of shares in our IPO net of issuance cost of \$131.6 million, proceeds from exercise of stock options of \$1.8 million offset by net repayment of debt of \$15.8 million.

Off-Balance Sheet Arrangements

We did not have any off-balance sheet arrangements during the years ended December 31, 2019, 2018 and 2017, as defined by applicable SEC rules and regulations.

Contractual Obligations

Our future minimum payments under our non-cancelable contractual obligations were as follows as of December 31, 2019 (in thousands):

	Payments Due by Period				
	Total	Less Than 1 Year	1 – 3 Years	3 – 5 Years	More Than 5 Years
Term Loan A Facility (1)	\$ 100,000	\$ 5,000	\$ 15,000	\$ 80,000	\$ —
Purchase commitments (2)	55,700	55,700	—	—	—
Operating lease obligations (3)	455,331	29,230	90,944	88,669	246,488
Other obligations (4)	67,199	51,313	15,436	450	—
Total	<u>\$ 678,230</u>	<u>\$ 141,243</u>	<u>\$ 121,380</u>	<u>\$ 169,119</u>	<u>\$ 246,488</u>

- (1) Represents the principal amount of Term Loan A Facility. For additional information regarding the terms of the debt and interest payable, see Note 10 to the Consolidated Financial Statements in Item 8 of this Annual Report on Form 10-K.
- (2) Represents commitments to purchase finished goods from our contract manufacturer and other inventory related items.
- (3) Represents future minimum lease payments under operating leases.
- (4) Represents commitments included in other non-cancelable arrangements like content licensing, advertising buys and other platform services.

We rely on outsourced suppliers to manufacture, assemble and test our players and audio devices. Consistent with industry practices, we enter into firm, non-cancelable, and unconditional purchase commitments to acquire products through a combination of purchase orders, supplier contracts, and open orders based on projected demand information. Our suppliers source components and build our products based on these demand forecasts. Changes to projected demand or in the subsequent sales mix of our products, may result in us being committed to purchase excess inventory to satisfy these commitments.

The contractual commitment amounts in the table above are associated with agreements that are enforceable and legally binding. Obligations under contracts that we can cancel without a significant penalty are not included.

As we are unable to reasonably predict the timing of settlement of liabilities related to unrecognized tax benefits, net, the table does not include \$19.5 million of such non-current liabilities not included in other liabilities on our consolidated balance sheet as of December 31, 2019.

Critical Accounting Policies and Estimates

Our financial statements are prepared in accordance with generally accepted accounting principles in the United States. The preparation of these financial statements requires us to make estimates and assumptions that affect the reported amounts of assets, liabilities, revenue, expenses and related disclosures. We evaluate our estimates and assumptions on an ongoing basis. Our estimates are based on historical experience, current trends and other factors that we believe to be reasonable at the time our consolidated financial statements are prepared. Our actual results could differ from these estimates.

The critical accounting policies requiring estimates, assumptions and judgments that we believe have the most significant impact on our financial statements are described below.

Revenue Recognition

We derive revenue primarily from platform services and sales of our players. We recognize revenue when control of promised products or services is transferred to customers, in an amount that reflects the consideration we expect to be entitled to in exchange for those products or services.

Our contracts with customers often include promises to transfer multiple products and services to a customer. Determining whether products and services are considered distinct performance obligations requires judgment. In a multiple element arrangement, revenue recognition of each distinct performance obligation in the estimated transaction price of a contract is based on the expected value for which a significant reversal of revenue is not expected to occur. The estimate of the variable consideration is based on the assessment of historical, current, and forecasted performance noted and expected from the performance obligation.

We compute transaction price of each contract and allocate that to each performance obligation based on a relative stand-alone selling price ("SSP"). Determining the SSP for each distinct performance obligation requires judgement. For performance obligations routinely sold separately, the SSP is determined by evaluating such stand-alone sales. For those performance obligations that are not routinely sold separately, we determine the SSP using information that may include market conditions and other observable inputs.

When we sell third-party goods and services, we evaluate whether we are the principal, and report revenues on a gross basis, or an agent, and report revenues on a net basis. Determining whether we are the principal or the agent in an arrangement requires judgement. In this assessment, we consider if we obtain control of the specified goods or services before they are transferred to the customer, as well as other indicators such as the party primarily responsible for fulfillment, inventory risk, and discretion in establishing price.

Our revenue is generated from the following two segments:

Platform segment:

Our platform segment generates revenue from sale of digital advertising, fees earned from the use of our platform, content distribution services including premium subscription services, sale of branded channel buttons on remote controls, and licensing arrangements with TV brands and service operators.

Our advertising revenue is mostly generated through video and display advertising delivered through advertising impressions. Advertising is typically sold on a cost-per-thousand ("CPM") basis and is evidenced by an Insertion Order, ("IO"). Revenue is recognized as the number of impressions are delivered. IOs may include multiple performance obligations as they contain distinct advertising products or services. For such arrangements, we allocate revenue to each distinct performance obligation based on its relative SSP. We also generate revenue from our customers using our platform, for which we charge a platform fee, which is a percentage of a customer's advertising inventory purchases during the month, plus data and any add-on features through the platform. We recognize revenue on either a gross or net basis for digital advertising based on our determination as to whether we are acting as the principal in the revenue generation process or as an agent. Where we are the principal, we control the advertising inventory before it is transferred to our customers. This is further supported by us being primarily responsible to our customers and having a level of discretion in establishing pricing. Digital advertising is comprised of performance obligations that are recognized either at a point in time or over time depending on the nature of the advertising product.

We earn content distribution revenue through various forms of revenue sharing arrangements with our content publishers. The revenue sharing arrangements generally apply to new subscriptions for accounts that sign up for new services on our platform and at the time of a movie rental or purchase. Revenue is recognized on a net basis as we are deemed to be the agent between content publishers and end users. The performance obligation is to distribute content publishers' content on our platform. Consequently, the portion of the gross amount billed to end users that is remitted to content publishers is not reflected as revenue. Revenue is recognized on a time elapsed basis, by day, as the services are delivered over the contractual distribution term.

We also sell monthly subscriptions for premium content available on The Roku Channel for varying fees for different content. We recognize revenue from such premium subscription fees on a gross basis over the service period as we are deemed to be the principal because we maintain the relationship with the end user, we obtain control of the content before transferring it to the end user, and we have latitude in establishing pricing. We pay fixed fees to the providers of premium content on The Roku Channel based on the contractual arrangement with them and recognize that as direct cost.

We sell branded channel buttons on player and TV remote controls that provide one-touch access to a publishers' content. We typically receive a fixed fee per button for each player or TV unit sold over a defined distribution period. Revenue is recognized on a time elapsed basis, by day, over the distribution term.

We license our technology and proprietary operating system to TV brands and service operators. Arrangements with TV brands commonly include a license to our technology and proprietary operating system over a specified term, including updates and upgrades. The revenue for licensing of technology and the Roku OS is recognized at a point in time, when the control has transferred to the customer, which usually occurs when we make the intellectual property available to the customer. The revenue allocated to unspecified upgrades is recognized on a time elapsed basis, by day, over the service period. Professional services revenue is recognized as services are provided or accepted. Hosting fees are recognized on a time elapsed basis, by day, over the service period. Arrangements may also include marketing development funds paid to TV brands. Marketing development funds are reflected as a reduction to the estimated transaction price.

To the extent platform services are part of a multiple element arrangement, revenue recognition of each distinct performance obligation in the estimated transaction price of a contract is based on the expected value for which a significant reversal of revenue is not expected to occur. The estimate of the variable consideration is based on the assessment of historical, current, and forecasted performance noted and expected from the performance obligation.

Player segment:

We sell the majority of our players through retail distribution channels, including brick and mortar, online retailers and through our website. Our player segment has two performance obligations. The hardware and embedded software are considered as one performance obligation and we recognize revenue at a point in time when control has transferred to the customer, which is based on the contractual terms. Our unspecified upgrades or enhancements are available to customers on a when-and-if available basis. We record the allocated value of the unspecified upgrades as deferred revenue and recognize it as player revenue ratably on a time elapsed basis over the estimated economic life of the associated players. Shipping charges billed to customers are included in revenue and the related shipping costs are included in cost of revenue.

Our player revenue includes allowances for returns and sales incentives in the estimated transaction price. The estimates for returns and sales incentives are based on historical experience and anticipated performance.

Business Combinations

We recognize, separately from goodwill, identifiable assets and liabilities acquired in a business combination at fair value on the date of acquisition. We use our best estimates and assumptions to accurately assign fair value to the tangible and identifiable intangible assets acquired and liabilities assumed at the acquisition date as well as the useful lives of those acquired intangible assets. Examples of critical estimates in valuing certain of the intangible assets and goodwill we have acquired include, but are not limited to, future expected cash inflows and outflows, expected technology life cycle, attrition rates of customers, and discount rates. We estimate the useful lives of the intangible assets based on the expected period over which we anticipate generating economic benefit from the asset. Unanticipated events and circumstances may occur that may affect the accuracy or validity of such assumptions, estimates or actual results.

While we use our best estimates and assumptions as part of the purchase price allocation process to accurately value assets and liabilities acquired, these estimates are inherently uncertain and subject to refinement. As a result, during the measurement period, which may be up to one year from the acquisition date, we record adjustments to the assets and liabilities acquired, with the corresponding offset to goodwill to the extent we identify adjustments to the

preliminary purchase price allocation. Upon the conclusion of the measurement period or final determination of the values of assets and liabilities assumed, whichever comes first, any subsequent adjustments are recorded to the consolidated statements of operations.

Goodwill and Intangible Assets

We test goodwill for impairment on an annual basis during the fourth quarter of each fiscal year or when specific circumstances dictate, between annual tests. We measure recoverability of goodwill at the reporting unit level. In performing our annual assessment, we first perform a qualitative test to determine whether it is more likely than not that the fair value of a reporting unit is less than its carrying value. If necessary, we then perform a quantitative test. To conduct the quantitative impairment test of goodwill, we compare the fair value of a reporting unit to its carrying value. We estimate the fair values of our reporting units using discounted cash flow models or other valuation models, such as comparative transactions and market multiples. If the reporting unit's carrying value exceeds its fair value, we record an impairment loss to the extent that the carrying value of goodwill exceeds its implied fair value. Different assumptions and judgment determinations could yield different conclusions that would result in an impairment charge to income in the period that such change or determination was made. When impaired, the carrying value of goodwill is written down to fair value.

We identify intangible assets acquired in a business combination and determine their fair value. The determination involves certain judgments and estimates. These judgments include, but are not limited to, the cash flows that an asset is expected to generate in the future and the appropriate discount weighted-average cost of capital. We amortize purchased-intangible assets on a straight-line basis over the estimated useful life of the assets. We review purchased-intangible assets whenever events or changes in circumstances indicate that the useful life is shorter than we had originally estimated or that the carrying amount of assets may not be recoverable. If such facts and circumstances exist, we assess the recoverability of purchased-intangible assets by comparing the projected undiscounted net cash flows associated with the related asset or group of assets over their remaining lives against their respective carrying amounts. Impairments, if any, are based on the excess of the carrying amount over the fair value of those assets. If the useful life of the asset is shorter than originally estimated, we accelerate the rate of amortization and amortize the remaining carrying value over the new shorter useful life.

Valuation of Inventory

We value inventory at the lower of cost or net realizable value with cost determined on a first-in, first-out basis. We base write-downs of inventories upon current facts and circumstances. We perform a detailed assessment of excess and obsolete inventory at each balance sheet date, which includes a review of, among other factors, demand requirements and market conditions. Based on this analysis, we record adjustments, when appropriate, to reflect inventory of finished products, materials on hand and purchase commitments at lower of cost or net realizable value. We establish a reserve for inventory or materials which are not forecasted to be consumed. Although we try to ensure the accuracy of our forecasts of player demand and pricing assumptions, any significant unanticipated changes in demand, pricing or technological developments could significantly impact the value of our inventory and our reported operating results. If we find that our supply estimates exceed our inventory demands, our inventory is written-down and charged to cost of revenue at the time of such determination. Conversely, if assumptions or circumstances beyond our control change and we subsequently sell players that have previously been written-down, our gross margin in the period of sale will be favorably impacted. The inventory provisions recorded are net of the reversals of provisions for sales of previously written-down inventory for each period presented.

Allowances for Returns, Sales Incentives and Doubtful Accounts

Accounts receivable are stated at invoice value less estimated allowances for returns, customer incentives and doubtful accounts. To determine the allowances for returns, sales incentives and doubtful accounts, we perform an ongoing analysis of various factors including our historical experience, recent write-offs and specific analysis of significant receivables that are past due. If our estimates regarding accounts receivable allowances differ from the actual results, the losses or gains, could be material.

Stock-Based Compensation

Stock-based compensation cost is measured at the grant date based on the fair value of the award and is recognized as an expense on a straight-line basis over the requisite service period, which is generally the vesting period of the respective award. Determining the fair value of stock-based awards at the grant date requires judgment.

We account for the fair value of restricted stock units using the closing market price of our Class A common stock on the date of the grant.

We use the Black-Scholes option-pricing model to determine the fair value of stock options. The determination of the grant date fair value of stock options using an option-pricing model is affected by our estimated common stock fair value as well as assumptions regarding a number of other complex and subjective variables. These variables include our expected stock price volatility over the expected term of the options, stock option exercise and cancellation behaviors, risk-free interest rates and expected dividends, which are estimated as follows:

- **Fair Value of Our Common Stock.** Prior to our IPO, the fair value of the common stock underlying our stock options was determined by our Board of Directors. The valuations of our common stock were determined in accordance with the guidelines outlined in the American Institute of Certified Public Accountants Practice Aid, Valuation of Privately-Held-Company Equity Securities Issued as Compensation. Our Board of Directors, with input from management, exercised significant judgment and considered numerous objective and subjective factors to determine the fair value of our common stock at each grant date, including but not limited to the prices, rights, preferences and privileges of our preferred stock relative to the common stock, our operating and financial performance, current business conditions and projections, our stage of development, likelihood of achieving a liquidity event for the shares of common stock underlying these stock options, such as an IPO or sale of our company, given prevailing market conditions, any adjustment necessary to recognize a lack of marketability of the common stock underlying the granted options, the market performance of comparable publicly-traded companies, and the U.S. and global capital market conditions.

Subsequent to our IPO, we use the market closing price for our Class A common stock as reported on The Nasdaq Global Select Market on the date of grant.

- **Expected Term.** The expected term of employee stock options represents the weighted-average period that the stock options are expected to remain outstanding. To determine the expected term, we generally apply the simplified approach in which the expected term of an award is presumed to be the mid-point between the vesting date and the expiration date of the award as we do not have sufficient historical exercise data to provide a reasonable basis for an estimate of expected term.
- **Volatility.** As we do not have sufficient trading history for our Class A common stock, the expected volatility for our Class A common stock is estimated by taking the average historic price volatility for industry peers based on daily price observations over a period equivalent to the expected term of the stock option awards. Industry peers consist of several public companies in our industry which are either similar in size, stage of life cycle or financial leverage. We intend to consistently apply this process until a sufficient amount of historical information regarding the volatility of our own Class A common stock share price becomes available or unless circumstances change such that the identified peer companies are no longer similar to us, in which case, more suitable companies whose share prices are available would be utilized in the calculation.
- **Risk-free Rate.** The risk-free interest rate is based on the yields of U.S. Treasury securities with maturities similar to the expected term for each of our stock options.
- **Dividend Yield.** We have never declared or paid any cash dividends and do not presently plan to pay cash dividends in the foreseeable future. Consequently, we use an expected dividend yield of zero.

We account for forfeitures as they occur. If any of the assumptions used in the Black-Scholes model changes significantly, stock-based compensation for future awards may differ materially compared with the awards granted previously.

We will continue to use judgement in evaluating assumptions related to our stock-based compensation cost. As we continue to accumulate additional data related to our Class A common stock and our business evolves, we may have refinements to our assumptions and estimates which could impact our future stock-based compensation cost.

Provision for Income Taxes

We account for income taxes in accordance with authoritative guidance, which requires the use of the asset and liability method. Under this method, deferred income tax assets and liabilities are determined based upon the difference between the consolidated financial statement carrying amounts and the tax basis of assets and liabilities and are measured using the enacted tax rate expected to apply to taxable income in the years in which the differences are expected to be reversed.

Deferred income taxes reflect the net tax effects of temporary differences between the carrying amounts of assets and liabilities for financial reporting purposes and the amounts used for income tax purposes. A valuation allowance is provided when it is more likely than not that the deferred tax assets will not be realized. We have established a full valuation allowance to offset domestic net deferred tax assets due to the uncertainty of realizing future tax benefits from our net operating loss carry-forwards and other deferred tax assets. Our valuation allowance is attributable to the uncertainty of realizing future tax benefits from U.S. net operating losses and other deferred tax assets.

Recent Accounting Pronouncements

In December 2019, the FASB issued ASU 2019-12, *Income Taxes (Topic 740): Simplifying the Accounting for Income Taxes*, to simplify the accounting for income taxes by removing certain exceptions to the general principles and also simplification of areas such as franchise taxes, step-up in tax basis goodwill, separate entity financial statements and interim recognition of enactment of tax laws or rate changes. The guidance is effective for fiscal years beginning after December 15, 2020, including interim reporting periods within those fiscal years, with early adoption permitted. We are currently in the process of evaluating the impact of this new guidance on the consolidated financial statements and the related disclosures.

In August 2018, the FASB issued ASU 2018-15, *Intangibles—Goodwill and Other—Internal-Use Software (Topic 350), Customer's Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement That Is a Service Contract*, which requires hosting arrangements that are service contracts to follow the guidance for internal-use software to determine which implementation costs can be capitalized. The guidance is effective either prospectively or retrospectively for fiscal years beginning after December 15, 2019, and interim periods within those fiscal years, with early adoption permitted. We are currently in the process of evaluating the effects of the new guidance but do not expect the impact from this standard to be material.

In August 2018, the FASB issued ASU 2018-13, *Fair Value Measurements (Topic 820), Disclosure Framework—Changes to the Disclosure Requirements for Fair Value Measurement*. The guidance removes, modifies, and adds certain disclosure requirements for fair value measurements. This pronouncement is effective for fiscal years, and for interim periods within those fiscal years, beginning after December 15, 2019, with early adoption permitted. We are currently in the process of evaluating the effects of the new guidance but do not expect the impact from this standard to be material.

In January 2017, the FASB issued ASU 2017-04, *Intangibles - Goodwill and Other (Topic 350): Simplifying the Test for Goodwill Impairment*. The guidance eliminates the requirement to calculate the implied fair value of goodwill to measure a goodwill impairment charge (i.e. Step 2 of the current guidance), instead measuring the impairment charge as the excess of the reporting unit's carrying amount over its fair value (i.e. Step 1 of the current guidance). The amendments in this update will be effective for fiscal years beginning after December 15, 2019 and should be applied prospectively. Early adoption is permitted for impairment testing dates after January 1, 2017. We are currently in the process of evaluating the effects of the new guidance but do not expect the impact from this standard to be material.

In June 2016, the FASB issued ASU No. 2016-13, *Financial Instruments - Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments*. The guidance amends reporting of credit losses for assets held at amortized cost basis and available-for-sale debt securities to require that credit losses on available-for-sale debt securities be presented as an allowance rather than as a write-down. The measurement of credit losses for newly recognized financial assets and subsequent changes in the allowance for credit losses are recorded in the statements of operations. The amendments in this update will be effective for fiscal years beginning after December 15, 2019. We are currently in the process of evaluating the effects of the new guidance but do not expect the impact from this standard to be material.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk

Interest Rate Fluctuation Risk

Our exposure to interest rate risk relates to the interest income generated by cash, cash equivalents and short-term investments and interest expense on the term loan. The primary objective of our investment activities is to preserve principal while maximizing income without significantly increasing risk. We do not believe that an increase or decrease in interest rates of 100 basis points would have a material effect on our operating results or financial condition. As of December 31, 2019, borrowings under the Term Loan A Facility totaled \$100.0 million with an effective interest rate of 3.48%. If the amount outstanding under our Term Loan A Facility remains at this level for an entire year and interest rates increased or decreased by 100 basis points, our annual interest expense would increase or decrease, respectively, by an additional \$1.0 million.

Foreign Currency Exchange Rate Risk

Most of our sales are currently within the United States and we have minimal foreign currency risk related to our revenue. In addition, most of our operating expenses are denominated in the U.S. dollar, resulting in minimal foreign currency risks. In the future, if our international sales increase or more of our expenses are denominated in currencies other than the U.S. dollar, our exposure to foreign currency risk will likely be more significant. For any of the periods presented, we did not enter into any foreign exchange contracts. However, in the future, we may enter into derivatives or other financial instruments in an attempt to hedge our foreign currency exchange risk.

Item 8. Financial Statements and Supplementary Data

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REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Stockholders and the Board of Directors of Roku, Inc.

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Roku, Inc. and subsidiaries (the “Company”) as of December 31, 2019 and 2018, the related consolidated statements of operations, comprehensive loss, convertible preferred stock and stockholders’ equity (deficit), and cash flows for each of the three years in the period ended December 31, 2019, and the related notes (collectively referred to as the “financial statements”). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2019 and 2018, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2019, in conformity with accounting principles generally accepted in the United States of America.

We have also audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company’s internal control over financial reporting as of December 31, 2019, based on criteria established in Internal Control—Integrated Framework (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission and our report dated February 28, 2020, expressed an unqualified opinion on the Company’s internal control over financial reporting.

Change in Accounting Principle

As discussed in Note 2 to the financial statements, the Company changed its method of accounting for leases in fiscal year 2019 due to the adoption of Accounting Standards Update No. 2016-02, *Leases (Topic 842)*, using the optional transition method, and as discussed in Note 3 to the financial statements, the Company changed its method of accounting for revenue in fiscal year 2018 due to the adoption of Accounting Standards Update No. 2014-09, *Revenue from Contracts with Customers (Topic 606)*, using the modified retrospective method.

Basis for Opinion

These financial statements are the responsibility of the Company’s management. Our responsibility is to express an opinion on the Company’s financial statements based on our audits. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the US federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

Critical Audit Matters

The critical audit matters communicated below are matters arising from the current-period audit of the financial statements that were communicated or required to be communicated to the audit committee and that (1) relate to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective, or complex judgments. The communication of critical audit matters does not alter in any way our opinion on the financial statements, taken as a whole, and we are not, by communicating the critical audit matters below, providing separate opinions on the critical audit matters or on the accounts or disclosures to which they relate.

Revenue Recognition—Variable Consideration Determination of Content Distribution Services and Branded Channel Buttons—Refer to Note 3 to the financial statements

Critical Audit Matter Description

As part of the Company's revenue recognition for its arrangements with content publishers, management is required to estimate variable consideration primarily related to content distribution services from transactional revenue sharing, and the sale of branded channel buttons on remote controls.

Variable consideration related to content distribution services with content publishers is included in the estimated transaction price based on the expected value for which a significant reversal of revenue is not expected to occur. For transactional revenue sharing arrangements, the estimate of the variable consideration is based on management's assessment of historical, current, and forecasted performance of the publisher's content application(s). For the sale of branded channel buttons on remote controls, the estimate of the variable consideration is based on management's assessment of historical, current, and forecasted player and Roku TV sales volumes.

We identified the revenue forecasts relating to content publisher arrangements as a critical audit matter due to the significant judgment necessary to estimate variable consideration and transaction prices. Such estimates required a high degree of auditor judgment and an increased extent of effort relative to evaluating the reasonableness of management's estimates and assumptions related to the forecasts of variable consideration.

How the Critical Audit Matter Was Addressed in the Audit

Our audit procedures related to management's forecast, used in the determination of future variable consideration, included the following, among others:

- We tested the effectiveness of controls over management's forecasting process related to content distribution services and branded channel buttons.
- We selected a sample of revenue arrangements with variable consideration and performed the following:
 - o Evaluated management's accuracy of forecasting by comparing the historical forecasts of consideration to actual consideration received;
 - o Obtained contractual documents for each selection, including master agreements, and other documents that were part of the agreement;
 - o Analyzed the contractual documents to determine if all arrangement terms that may have an impact on revenue recognition were identified and properly considered in the evaluation of the accounting for the contract, including terms and conditions for revenue sharing;
 - o Evaluated changes from prior period forecasts to current period forecasts, when applicable;
 - o Performed inquiries with applicable individuals in the Company's sales department regarding the estimates for sales of branded channel buttons to corroborate evidence obtained around such estimates;
 - o Compared management's forecasts of variable consideration to historical data, other information within the Company, and certain publicly available industry information, when applicable;
 - o Tested the mathematical accuracy of the compilation of the forecast.

Business Combination - Refer to Note 4 to the consolidated financial statements**Critical Audit Matter Description**

On November 8, 2019, the Company completed the acquisition of dataxu, Inc. ("dataxu") for \$148.4 million. The Company allocated the fair value of the purchase consideration to the tangible and intangible assets acquired and liabilities assumed based on their estimated fair values. The Company estimated the fair value of identifiable intangible assets to be \$70.2 million. The excess purchase price over the fair value of net tangible assets and identifiable intangible assets of \$72.7 million was recorded as goodwill.

We identified the fair value determination of acquired intangible assets and the resulting goodwill for the business combination as a critical audit matter due to the significant judgement required in determining significant estimates

related to the dataxu acquisition. Management's estimates of forecasted discounted cash flows included significant assumptions for revenue growth rates and the selection of an appropriate discount rate. There was a high degree of auditor judgment and subjectivity in applying audit procedures relating to the fair value measurement of intangible assets acquired due to the significant amount of judgment by management when developing its estimates. Significant audit effort was required in performing procedures and evaluating the significant assumptions relating to the estimate and the audit effort involved the use of professionals with specialized skill and knowledge to assist in evaluating the audit evidence obtained from these procedures.

How the Critical Audit Matter Was Addressed in the Audit

Our audit procedures related to management's estimates for the fair value of intangible assets included the following, among others:

- We tested the effectiveness of controls over the business combination, including controls over the modelling of future cash flows, the determination of the revenue growth rates, expense and discount rate assumptions, and ultimately the determination of the fair value of the intangible assets acquired;
- We assessed the reasonableness of management's revenue growth rate assumptions by comparing the projected revenue to the acquiree's historical results as well as those of certain peer companies, including testing the completeness, accuracy, and relevance of underlying historical data;
- We assessed the reasonableness of management's assumptions related to forecasted cost of revenue, research and development, and sales and marketing expenses by comparing the projected expenses to the acquired company's historical results and those of certain peer companies, including testing the completeness, accuracy, and relevance of underlying historical data;
- With the assistance of our fair value specialists, we evaluated the reasonableness of the (1) valuation methodology and (2) discount rates, including testing the underlying source information, testing the mathematical accuracy of the calculation, and developing a range of independent estimates and comparing those to the discount rates selected by management;
- Inquiries with appropriate individuals within the Company's operations, engineering and finance departments regarding the revenue growth rate assumption as well as estimates related to cost of revenue, research and development and sales and marketing expenses;
- Evaluating whether the audit evidence obtained through these procedures was consistent with evidence obtained in other areas of the audit.

/s/ DELOITTE & TOUCHE LLP

San Jose, California

February 28, 2020

We have served as the Company's auditor since 2008.

ROKU, INC.
CONSOLIDATED BALANCE SHEETS
(in thousands, except par value)

	As of December 31,	
	2019	2018
Assets		
Current Assets:		
Cash and cash equivalents	\$ 515,479	\$ 155,564
Short-term investments	—	42,146
Restricted cash	1,854	—
Accounts receivable, net of allowances of \$27,521 and \$21,897 as of December 31, 2019 and 2018, respectively	332,673	183,078
Inventories	49,714	35,585
Prepaid expenses and other current assets	25,943	16,562
Total current assets	925,663	432,935
Property and equipment, net	103,262	25,264
Operating lease right-of-use assets	283,291	—
Intangible assets, net	76,668	1,477
Goodwill	74,116	1,382
Other non-current assets	7,234	3,939
Total Assets	\$ 1,470,234	\$ 464,997
Liabilities and Stockholders' Equity		
Current Liabilities:		
Accounts payable	\$ 115,227	\$ 56,576
Accrued liabilities	198,347	91,986
Current portion of long-term debt	4,866	—
Deferred revenue, current portion	39,861	45,442
Total current liabilities	358,301	194,004
Long-term debt, non-current portion	94,742	—
Deferred revenue, non-current portion	15,370	19,594
Operating lease liability, non-current	301,694	—
Other long-term liabilities	1,701	6,748
Total Liabilities	771,808	220,346
Commitments and contingencies (Note 12)		
Stockholders' Equity:		
Preferred stock, \$0.0001 par value;	—	—
10,000 shares authorized as of December 31, 2019 and 2018;		
no shares issued and outstanding as of December 31, 2019 and 2018		
Common stock, \$0.0001 par value;	12	11
1,150,000 (Class A - 1,000,000 and Class B - 150,000) shares authorized as of December 31, 2019 and 2018;		
119,897 (Class A - 93,574 and Class B - 26,323) shares and		
109,770 (Class A - 77,820 and Class B - 31,950) shares		
issued and outstanding as of December 31, 2019 and 2018, respectively		
Additional paid-in capital	1,012,218	498,553
Accumulated other comprehensive loss	29	(17)
Accumulated deficit	(313,833)	(253,896)
Total stockholders' equity	698,426	244,651
Total Liabilities and Stockholders' Equity	\$ 1,470,234	\$ 464,997

See accompanying Notes to Consolidated Financial Statements.

ROKU, INC.
CONSOLIDATED STATEMENTS OF OPERATIONS
(in thousands, except per share data)

	Years Ended December 31,		
	2019	2018	2017
Net Revenue:			
Platform	\$ 740,776	\$ 416,863	\$ 225,356
Player	388,145	325,643	287,407
Total net revenue	<u>1,128,921</u>	<u>742,506</u>	<u>512,763</u>
Cost of Revenue:			
Platform	262,655	120,543	54,826
Player	371,042	289,815	258,104
Total cost of revenue	<u>633,697</u>	<u>410,358</u>	<u>312,930</u>
Gross Profit:			
Platform	478,121	296,320	170,530
Player	17,103	35,828	29,303
Total gross profit	<u>495,224</u>	<u>332,148</u>	<u>199,833</u>
Operating Expenses:			
Research and development	265,011	170,692	107,945
Sales and marketing	178,855	102,780	64,069
General and administrative	116,417	71,972	47,435
Total operating expenses	<u>560,283</u>	<u>345,444</u>	<u>219,449</u>
Loss from Operations	<u>(65,059)</u>	<u>(13,296)</u>	<u>(19,616)</u>
Other Income (Expense), Net:			
Interest expense	(2,366)	(346)	(1,612)
Loss on extinguishment of debt	—	—	(2,338)
Change in fair value of preferred stock warrant liability	—	—	(40,333)
Other income (expense), net	6,506	4,309	705
Total other income (expense), net	<u>4,140</u>	<u>3,963</u>	<u>(43,578)</u>
Loss Before Income Taxes	<u>(60,919)</u>	<u>(9,333)</u>	<u>(63,194)</u>
Income tax (benefit) expense	(982)	(476)	315
Net Loss Attributable to Common Stockholders	<u>\$ (59,937)</u>	<u>\$ (8,857)</u>	<u>\$ (63,509)</u>
Net loss per share attributable to common stockholders—basic and diluted	<u>\$ (0.52)</u>	<u>\$ (0.08)</u>	<u>\$ (2.24)</u>
Weighted-average shares used in computing net loss per share attributable to common stockholders—basic and diluted	<u>115,218</u>	<u>104,618</u>	<u>28,308</u>

See accompanying Notes to Consolidated Financial Statements.

ROKU, INC.
CONSOLIDATED STATEMENTS OF COMPREHENSIVE LOSS
(in thousands)

	Years Ended December 31,		
	2019	2018	2017
Net Loss Attributable to Common Stockholders	\$ (59,937)	\$ (8,857)	\$ (63,509)
Other comprehensive gain (loss), net of tax:			
Unrealized gain (loss) on short-term investments, net of tax	17	(17)	—
Foreign currency translation adjustment	29	—	—
Other comprehensive gain (loss), net of tax	46	(17)	—
Comprehensive Net Loss	<u>\$ (59,891)</u>	<u>\$ (8,874)</u>	<u>\$ (63,509)</u>

See accompanying Notes to Consolidated Financial Statements

ROKU, INC.
CONSOLIDATED STATEMENTS OF CONVERTIBLE PREFERRED STOCK AND STOCKHOLDERS' EQUITY (DEFICIT)
(in thousands)

	Convertible Preferred Stock		Common Stock		Additional Paid-in Capital	Treasury Stock	Accumulated Other Comprehensive Loss	Accumulated Deficit	Total Stockholders' Equity (Deficit)
	Shares	Amount	Shares	Amount					
Balance—December 31, 2016	80,844	\$ 213,180	4,819	\$ —	\$ 26,005	\$ —	\$ —	\$ (219,829)	\$ (193,824)
Issuance of common stock upon exercise of stock options	—	—	963	1	2,086	—	—	—	2,087
Share repurchases	—	—	(92)	—	—	(671)	—	—	(671)
Vesting of early exercised stock options	—	—	—	—	62	—	—	—	62
Stock-based compensation expense	—	—	—	—	10,953	—	—	—	10,953
Issuance of common stock pursuant to an acquisition	—	—	108	—	—	—	—	—	—
Issuance of common stock upon exercise of common and preferred warrants	—	—	2,165	—	—	—	—	—	—
Issuance of common stock pursuant to an initial public offering, net of issuance costs of \$3.1 million	—	—	10,350	1	131,645	—	—	—	131,646
Conversion of preferred stock into common stock pursuant to an initial public offering	(80,844)	(213,180)	80,844	8	213,172	—	—	—	213,180
Reclassification of preferred stock warrants liability to additional paid-in-capital upon conversion to common stock warrants	—	—	—	—	52,355	—	—	—	52,355
Net loss	—	—	—	—	—	—	—	(63,509)	(63,509)
Balance—December 31, 2017	—	—	99,157	10	436,278	(671)	—	(283,338)	152,279
Vesting of early exercised stock options	—	—	—	—	239	—	—	—	239
Issuance of common stock pursuant to equity incentive plans, net of taxes	—	—	10,481	1	25,033	—	—	—	25,034
Issuance of common stock pursuant to exercise of common stock warrants, net	—	—	141	—	—	—	—	—	—
Stock-based compensation expense	—	—	—	—	37,674	—	—	—	37,674
Share repurchases	—	—	(9)	—	—	—	—	—	—
Adoption of ASU 2016-16	—	—	—	—	—	—	—	(40)	(40)
Adoption of ASU 2014-09	—	—	—	—	—	—	—	38,339	38,339
Unrealized loss on short-term investments	—	—	—	—	—	—	(17)	—	(17)
Net loss	—	—	—	—	—	—	—	(8,857)	(8,857)
Balance—December 31, 2018	—	—	109,770	11	499,224	(671)	(17)	(253,896)	244,651
Vesting of early exercised stock options	—	—	—	—	86	—	—	—	86
Share repurchases	—	—	(2)	—	—	—	—	—	—
Issuance of common stock pursuant to equity incentive plans, net of taxes	—	—	6,169	1	28,181	—	—	—	28,182
Issuance of common stock pursuant in connection with at-the-market offerings, net of issuance costs of \$6.4 million	—	—	3,389	—	330,539	—	—	—	330,539
Issuance of common stock in connection with acquisition	—	—	571	—	69,684	—	—	—	69,684
Stock-based compensation expense	—	—	—	—	85,175	—	—	—	85,175
Unrealized gain on short-term investments	—	—	—	—	—	—	17	—	17
Foreign currency translation adjustment	—	—	—	—	—	—	29	—	29
Net loss	—	—	—	—	—	—	—	(59,937)	(59,937)
Balance—December 31, 2019	—	—	119,897	12	\$ 1,012,889	\$ (671)	\$ 29	\$ (313,833)	\$ 698,426

See accompanying Notes to Consolidated Financial Statements.

ROKU, INC.
CONSOLIDATED STATEMENTS OF CASH FLOWS
(in thousands)

	Years Ended December 31,		
	2019	2018	2017
Cash flows from operating activities:			
Net loss	\$ (59,937)	\$ (8,857)	\$ (63,509)
Adjustments to reconcile net loss to net cash provided by operating activities:			
Depreciation and amortization	15,669	8,389	5,336
Stock-based compensation expense	85,175	37,674	10,953
Provision for doubtful accounts	704	876	104
Change in fair value of preferred stock warrant liability	—	—	40,333
Noncash interest expense	531	342	784
(Gain) Loss from exit of facilities and disposal of property and equipment	(2)	1,128	579
Loss from extinguishment of debt	—	—	2,338
Impairment of long-lived assets	854	352	—
Amortization of premiums on short-term investments	(282)	(357)	—
Changes in operating assets and liabilities:			
Accounts receivable	(110,225)	(50,673)	(41,184)
Inventories	(14,129)	(2,953)	10,828
Prepaid expenses and other current assets	(11,566)	(306)	(6,514)
Operating lease right-of-use assets	22,328	—	—
Deferred cost of revenue	1,143	2,261	(1,959)
Other noncurrent assets	(3,060)	(732)	(2,794)
Accounts payable	9,409	(98)	24,315
Accrued liabilities	79,058	17,914	24,127
Operating lease liabilities	11,658	—	—
Other long-term liabilities	(3,024)	(1,101)	3,579
Deferred revenue	(10,597)	10,063	29,976
Net cash provided by operating activities	<u>13,707</u>	<u>13,922</u>	<u>37,292</u>
Cash flows from investing activities:			
Purchase of property and equipment	(77,180)	(18,327)	(9,229)
Purchase of business, net of cash acquired	(68,132)	—	(2,959)
Purchase of intangible assets	(7,428)	—	—
Purchases of short-term investments	(12,365)	(53,806)	—
Sales/maturities of short-term investments	54,810	12,000	—
Change in deposits	—	—	(80)
Net cash used in investing activities	<u>(110,295)</u>	<u>(60,133)</u>	<u>(12,268)</u>
Cash flows from financing activities:			
Proceeds from borrowings, net of issuance costs	99,608	—	24,691
Repayments of borrowings	—	—	(40,446)
Holdback payment for a prior business acquisition	—	(500)	—
Proceeds from equity issued under incentive plans, net of repurchases	28,181	25,025	1,773
Proceeds from equity issued under at-the-market program, net of offering costs	330,539	—	—
Proceeds from issuance of common stock pursuant to an initial public offering, net of issuance costs	—	—	131,646
Net cash provided by financing activities	<u>458,328</u>	<u>24,525</u>	<u>117,664</u>
Net Increase (Decrease) in cash, cash equivalents and restricted cash	<u>361,740</u>	<u>(21,686)</u>	<u>142,688</u>
Effect of exchange rate changes on cash, cash equivalents and restricted cash	29	—	—
Cash, cash equivalents and restricted cash — Beginning of period	155,564	177,250	34,562
Cash, cash equivalents and restricted cash — End of period	<u>\$ 517,333</u>	<u>\$ 155,564</u>	<u>\$ 177,250</u>
Cash, cash equivalents and restricted cash at end of period:			
Cash and cash equivalents	515,479	155,564	177,250
Restricted cash	1,854	—	—
Cash, cash equivalents and restricted cash — End of period	<u>\$ 517,333</u>	<u>\$ 155,564</u>	<u>\$ 177,250</u>

	Years Ended December 31,		
	2019	2018	2017
Supplemental disclosures of cash flow information:			
Cash paid for interest	\$ 3,095	\$ 493	\$ 1,149
Cash paid for income taxes	\$ 759	\$ 564	\$ 222
Supplemental disclosures of noncash investing and financing activities:			
Issuance of common stock for business combinations	\$ 69,684	\$ —	\$ —
Unpaid portion of property and equipment purchases	\$ 10,762	\$ 1,617	\$ 1,250
Unpaid portion of acquisition related expenses	\$ 2,190	\$ —	\$ —
Unpaid portion of purchased intangibles	\$ 400	\$ —	\$ —
Unpaid portion of at-the-market offering costs	\$ 144	\$ —	\$ —
Fair value of preferred stock warrants reclassified to additional paid in capital	\$ —	\$ —	\$ 52,355
Issuance of convertible preferred stock warrants in connection with debt	\$ —	\$ —	\$ 2,032

See accompanying Notes to Consolidated Financial Statements.

ROKU, INC.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

1. THE COMPANY

Organization and Description of Business

Roku, Inc. (the “Company” or “Roku”), was formed in October 2002 as Roku LLC under the laws of the State of Delaware. On February 1, 2008, Roku LLC was converted into Roku, Inc., a Delaware corporation. The Company’s TV streaming platform allows users to easily discover and access a wide variety of movies and TV episodes, as well as live sports, music, news and more. The Company operates in two reportable segments and generates platform revenue from advertising, content distribution, audience development, billing services and licensing activities and player revenue from the sale of streaming players and audio products.

Initial Public Offering

On October 2, 2017, the Company completed its initial public offering (“IPO”), of Class A common stock, in which it sold 10.4 million shares, including 1.4 million shares pursuant to the underwriters’ over-allotment option. The shares were sold at an IPO price of \$14.00 per share for net proceeds of \$134.8 million, after deducting underwriting discounts and commissions of \$10.1 million. Additionally, offering costs incurred by the Company were \$3.1 million. Upon the closing of the Company’s IPO, all outstanding shares of its convertible preferred stock automatically converted into 80.8 million shares of Class B common stock and all outstanding convertible preferred stock warrants automatically converted to Class B common stock warrants on a one-for-one basis. Following the IPO, the Company has two classes of authorized common stock – Class A common stock and Class B common stock. Class A common stock entitles holders to one vote per share, and Class B common stock entitles holders to 10 votes per share.

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Basis of Presentation and Principles of Consolidation

The consolidated financial statements, which include the accounts of Roku, Inc. and its wholly-owned subsidiaries, have been prepared in conformity with accounting principles generally accepted in the United States (“U.S. GAAP”). All intercompany accounts and transactions have been eliminated in consolidation.

Use of Estimates

The preparation of the Company’s consolidated financial statements in accordance with U.S. GAAP requires management to make certain estimates, judgements, and assumptions that affect the reported amounts of assets, liabilities, net revenue and expenses. Significant items subject to such estimates and assumptions include: for revenue recognition, determining the nature and timing of satisfaction of performance obligations, variable consideration, determining the stand-alone selling prices of performance obligations, gross versus net revenue recognition, evaluation of customer versus vendor relationships, and other obligations such as sales return reserves and customer incentive programs; the fair value or impairment of goodwill and intangible assets; useful lives of tangible and intangible assets; allowances for doubtful accounts; the valuation of inventory, the valuation of deferred income tax assets; the recognition and disclosure of contingent liabilities and stock-based compensation. The Company bases its estimates on historical experience and on various other assumptions that the Company believes to be reasonable under the circumstances. Actual results may differ from the Company’s estimates and assumptions.

Comprehensive Loss

Comprehensive loss includes unrealized gains on the Company's short-term investments and foreign currency translation adjustments for the year ended December 31, 2019. Comprehensive loss includes unrealized losses on the Company's short-term investments for the year ended December 31, 2018. During the year ended December 31, 2017, the Company had no short-term investments, and, as a result, comprehensive loss was equal to the net loss for the year ended December 31, 2017. Income taxes on the unrealized loss are not material.

Foreign Currency

The functional currency of most of the Company's foreign subsidiaries is the U.S. dollar. Monetary assets and liabilities of these subsidiaries are remeasured into U.S. dollars from the local currency at rates in effect at period-end and nonmonetary assets and liabilities are remeasured at historical rates. Revenues and expenses are remeasured at average exchange rates in effect during each period. Foreign currency gains or losses from re-measurement and transaction gains or losses are recorded as other income (expense), net in the consolidated statements of operations. During the years ended December 31, 2019 and 2018, the Company recorded a foreign currency loss of \$0.2 million and \$0.5 million, respectively. During the year ended December 31, 2017, the Company recorded a foreign currency gain of \$0.1 million.

The functional currency for one of the Company's foreign subsidiaries is its local currency. The Company translates the assets and liabilities of its non-U.S. dollar functional currency subsidiary into U.S. dollars using exchange rates in effect at the end of each reporting period. Revenues and expenses are translated using rates that approximate those in effect during the period. Gains and losses from these translations are recognized as cumulative translation adjustment and included in accumulated other comprehensive loss in stockholder's equity.

Concentrations

Financial instruments, which potentially subject the Company to concentrations of credit risk, consist principally of cash, cash equivalents, short-term investments and accounts receivable. As of December 31, 2019, two financial institutions managed 65% and 34% of the Company's cash and cash equivalents balance, respectively. As of December 31, 2018, 97% of the Company's cash and cash equivalents balance was managed by one financial institution.

Accounts receivable are typically unsecured and are derived from revenue earned from customers. They are stated at invoice value less estimated allowances for returns, customer incentives and doubtful accounts. The Company performs ongoing credit evaluations of its customers and maintains allowances for potential credit losses.

Customers accounting for 10% or more of the Company's net revenue were as follows:

	Years Ended December 31,		
	2019	2018	2017
Customer B	*	*	10%
Customer C	14%	18%	20%
Customer E	*	*	10%

Customers accounting for 10% or more of the Company's accounts receivable were as follows:

	As of December 31,	
	2019	2018
Customer D	*	11%

Business Combinations

The Company determines whether a transaction meets the definition of a business combination before applying the acquisition method of accounting to that transaction. The Company allocates the fair value of the purchase consideration of its acquisitions to the tangible and intangible assets acquired and liabilities assumed.

based on their estimated fair values. The excess of the fair value of purchase consideration over the fair values of identifiable assets and liabilities is recorded as goodwill. The operating results of acquired business is included in the Company's consolidated statement of operations beginning on their effective acquisition date. Acquisition-related expenses and certain acquisition restructuring and other related charges are recognized separately from the business combination and are expensed as incurred.

Contingent consideration arrangements are recognized at fair value as of the acquisition date with subsequent fair value adjustments recorded in operations. Additional information regarding the Company's contingent consideration arrangement is included in Note 4, Business Combinations.

While the Company uses its best estimates and assumptions to accurately value assets acquired and liabilities assumed at the acquisition date, estimates are inherently uncertain and subject to refinement. As a result, during the measurement period, which may be up to one year from the acquisition date, the Company may record adjustments to the assets acquired and liabilities assumed with the corresponding offset to goodwill. In addition, uncertain tax positions and tax-related valuation allowances are initially recorded in connection with a business combination as of the acquisition date. The Company continues to collect information and reevaluates these estimates and assumptions quarterly and records any adjustments to the Company's preliminary estimates to goodwill provided that the Company is within the measurement period. Upon the conclusion of the measurement period or final determination of the values of assets acquired or liabilities assumed, whichever comes first, any subsequent adjustments are recorded to our consolidated statements of operations.

Intangible Assets

Purchased intangible assets are carried at cost, net of accumulated amortization. Intangible assets are amortized primarily using the straight-line method over their estimated useful lives. The Company evaluates the estimated remaining useful lives of its intangible assets annually and when events or changes in circumstances warrant a revision to the remaining periods of amortization.

Impairment Assessment

The Company evaluates goodwill for possible impairment at least annually during the fourth quarter of each fiscal year or more often, if and when circumstances indicate that goodwill may be impaired. This includes but is not limited to significant adverse changes in the business climate, market conditions, or other events that indicate that it is more likely than not that the fair value of a reporting unit is less than its carrying value. In performing its annual goodwill assessment, the Company first performs a qualitative test and if necessary, then performs a quantitative test. To conduct the quantitative impairment test of goodwill, the Company compares the fair value of a reporting unit to its carrying value. The Company estimates the fair values of its reporting unit using discounted cash flow models or other valuation models, such as comparative transactions and market multiples. If the reporting unit's carrying value exceeds its fair value, the Company records an impairment loss to the extent that the carrying value of goodwill exceeds its implied fair value.

The Company reviews long-lived assets and intangible assets with finite lives for impairment at least annually or more often when events or changes in business circumstances indicate that the carrying amount of the assets may not be fully recoverable or that the useful lives of those assets are no longer appropriate. If impairment is indicated, the Company writes down the asset to its estimated fair value.

The Company did not recognize any impairment for goodwill and intangible assets in any periods. The Company recorded \$0.9 million in impairment to operating right-of-use assets during the year ended December 31, 2019 and \$0.4 million in impairment to property and equipment during the year ended December 31, 2018 for assets that are no longer in use. The Company did not record any impairment during the year ended December 31, 2017.

Fair Value of Financial Instruments

The Company defines fair value as the price that would be received from selling an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. The Company applies fair value accounting for all assets and liabilities that are recognized or disclosed at fair value in the consolidated

financial statements. The carrying amounts reported in the consolidated financial statements for cash and cash equivalents, short-term investments, accounts receivable, accounts payable and accrued liabilities approximate their fair values due to their short-term nature. The carrying amount of debt approximates fair value due to its variable interest rates.

Short-Term Investments

The Company considers investments in highly liquid instruments purchased with an original maturity of 90 days or less to be cash equivalents. The Company's short-term investments consist of corporate bonds, commercial paper and U.S. Government agency securities. These investments are held in the custody of one major financial institution. As of December 31, 2019, the Company did not own any short-term investments. As of December 31, 2018, the short-term investments were classified as available-for-sale and were recorded at fair value in the consolidated balance sheet with net unrealized gains or losses reported as a separate component of accumulated other comprehensive income (loss), net of tax.

The Company recognizes an impairment charge if a decline in the fair value of its investments is considered to be other-than-temporary. The Company has determined that gross unrealized losses on short-term investments at December 31, 2018 were temporary in nature because each investment meets the Company's credit quality requirements and the Company has the ability and intent to hold these investments until they recover their unrealized losses.

Inventories

The Company's inventories consist primarily of finished goods and are stated at the lower of cost or net realizable value with cost determined on a first-in, first-out basis. Provisions are made if the cost of the inventories exceeds their net realizable value. The Company evaluates inventory levels and purchase commitments for excess and obsolete products, based on management's assessment of future demand and market conditions.

Property and Equipment

Property and equipment are recorded at cost and depreciated using the straight-line method over their estimated useful lives of the assets, generally ranging between eighteen months and five years. Leasehold improvements are amortized over the shorter of the lease term or their estimated useful lives, which range from five to ten years. The Company capitalizes costs to develop its website and internal-use software. Costs that relate to the planning and post-implementation phases of development are expensed as incurred. Subsequent costs are capitalized when preliminary efforts are successfully completed, management has authorized and committed to funding the project, and it is probable that the project will be completed and will be used as intended. Costs incurred for enhancements that are expected to result in additional material functionality are capitalized. During the years ended December 31, 2019, 2018 and 2017, the Company capitalized website and internal-use software development costs of \$0.1 million, \$1.0 million and \$2.6 million, respectively.

Capitalized costs are amortized using the straight-line method over the estimated useful life of the asset, which is generally two years, beginning when the asset is ready for its intended use. During the years ended December 31, 2019, 2018 and 2017, the Company amortized expenses of \$1.6 million, \$2.0 million and \$1.1 million, respectively.

Content Licensing Fees

The Company licenses content for viewing on The Roku Channel. The licensing arrangements can be for a fixed fee and/or advertising revenue share with specific windows of availability. The Company capitalizes the content fees and records a corresponding liability at the gross amount of the liability when the license period begins, the cost of the content is known, and the content is accepted and available for streaming. The Company amortizes licensed content assets into "Cost of Revenue, Platform" over the contractual window of availability.

As of December 31, 2019, content related expenses that met these requirements were \$1.7 million. As of December 31, 2018, content related expenses that met these requirements were not material.

Deferred Revenue

The Company's deferred revenue reflects fees received from licensing and service arrangements, including advertising, that will be recognized as revenue over time or as services are rendered. Deferred revenue balances consist of the amount of player sales allocated to unspecified upgrades or enhancements on a when-and-if available basis, licensing and services fees from service operators and TV brands, and payments from advertisers and content publishers. Deferred revenue expected to be realized within one year is classified as current liabilities and the remaining is recorded as noncurrent liabilities.

Advertising Costs

Advertising costs are expensed when incurred and are included in sales and marketing expense in the consolidated statements of operations. The Company incurred advertising costs of \$7.3 million, \$3.0 million and \$3.4 million for the years December 31, 2019, 2018 and 2017, respectively.

Stock-Based Compensation

The Company measures compensation expense for all stock-based awards, including restricted stock units and stock options granted to employees, based on the estimated fair value of the award on the date of grant. For restricted stock units, the grant date fair value is based on the closing market price of the Company's Class A common stock on the date of grant. The fair value of each stock option is estimated using the Black-Scholes option-pricing model. The Company accounts for forfeitures as they occur. Stock-based compensation is recognized on a straight-line basis over the requisite vesting period.

Income Taxes

The Company accounts for income taxes using an asset and liability approach. Deferred tax assets and liabilities are determined based on the difference between the consolidated financial statement and tax basis of assets and liabilities using enacted tax rates in effect for the year in which the differences are expected to affect taxable income. Valuation allowances are established when necessary to reduce deferred tax assets to the amounts that are more likely than not to be realized.

Net Loss per Share

Since the Company was in a loss position for all periods presented, basic net loss per share is the same as diluted net loss per share for all periods as the inclusion of all potential common shares outstanding and potentially dilutive securities would have been anti-dilutive.

Adoption of New Accounting Standards

In February 2016, the Financial Accounting Standards Board ("FASB") issued ASU 2016-02, *Leases (Topic 842)* ("ASC 842"), in order to increase transparency and comparability among organizations by recognizing lease assets and lease liabilities on the balance sheet for those leases classified as operating leases under prior GAAP. ASU 2016-02 requires that a lessee should recognize a liability to make lease payments (the lease liability) and a right-of-use asset representing its right to use the underlying asset for the lease term on the balance sheet.

On January 1, 2019, the Company adopted the guidance in ASC 842 using the optional transition method and recorded right-of-use ("ROU") assets and lease liabilities on its consolidated balance sheet. As a result, periods prior to 2019 were not adjusted. On the adoption date, the Company recognized ROU assets totaling \$39.9 million, lease liabilities totaling \$42.1 million and reclassification of deferred and prepaid rents of \$2.2 million to ROU assets on its consolidated balance sheet. There was no impact to the accumulated deficit. The Company elected the package of practical expedients permitted under the transition guidance that allowed, among other things, the historical lease classification to be carried forward without reassessment. The Company did not elect the hindsight practical expedient to determine the lease term for existing leases. Refer to Note 9, Leases, for additional disclosures.

Recently Issued Accounting Pronouncements Not Yet Adopted

In December 2019, the FASB issued ASU 2019-12, *Income Taxes (Topic 740): Simplifying the Accounting for Income Taxes*, to simplify the accounting for income taxes by removing certain exceptions to the general principles and also simplification of areas such as franchise taxes, step-up in tax basis goodwill, separate entity financial statements and interim recognition of enactment of tax laws or rate changes. The guidance is effective for fiscal years beginning after December 15, 2020, including interim reporting periods within those fiscal years, with early adoption permitted. The Company is currently in the process of evaluating the impact of this new guidance on the consolidated financial statements and the related disclosures.

In August 2018, the FASB issued ASU 2018-15, *Intangibles—Goodwill and Other—Internal-Use Software (Topic 350), Customer's Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement That Is a Service Contract*, which requires hosting arrangements that are service contracts to follow the guidance for internal-use software to determine which implementation costs can be capitalized. The guidance is effective either prospectively or retrospectively for fiscal years beginning after December 15, 2019, and interim periods within those fiscal years, with early adoption permitted. The Company is currently in the process of evaluating the impact of this new guidance on the consolidated financial statements but does not expect the impact to be material.

In August 2018, the FASB issued ASU 2018-13, *Fair Value Measurements (Topic 820), Disclosure Framework—Changes to the Disclosure Requirements for Fair Value Measurement*. This standard removes, modifies, and adds certain disclosure requirements for fair value measurements. This pronouncement is effective for fiscal years, and for interim periods within those fiscal years, beginning after December 15, 2019, with early adoption permitted. The Company is currently in the process of evaluating the effects of the new guidance but does not expect the impact from this standard to be material.

In January 2017, the FASB issued ASU 2017-04, *Intangibles - Goodwill and Other (Topic 350): Simplifying the Test for Goodwill Impairment*. The guidance eliminates the requirement to calculate the implied fair value of goodwill to measure a goodwill impairment charge (i.e. Step 2 of the current guidance), instead measuring the impairment charge as the excess of the reporting unit's carrying amount over its fair value (i.e. Step 1 of the current guidance). The amendments in this update will be effective for fiscal years beginning after December 15, 2019 and should be applied prospectively. Early adoption is permitted for impairment testing dates after January 1, 2017. The Company is currently in the process of evaluating the effects of the new guidance but does not expect the impact from this standard to be material.

In June 2016, the FASB issued ASU No. 2016-13, *Financial Instruments - Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments*. The guidance amends reporting of credit losses for assets held at amortized cost basis and available-for-sale debt securities to require that credit losses on available-for-sale debt securities be presented as an allowance rather than as a write-down. The measurement of credit losses for newly recognized financial assets and subsequent changes in the allowance for credit losses are recorded in the statements of operations. The amendments in this update will be effective for fiscal years beginning after December 15, 2019. The Company is currently in the process of evaluating the effects of the new guidance but does not expect the impact from this standard to be material.

3. REVENUE

The Company adopted accounting guidance in Accounting Standards Codification, *Revenue from Contracts with Customers (Topic 606)* ("ASC 606"), effective January 1, 2018, using the modified retrospective method. Accordingly, the financial results for the year ended December 31, 2017 have not been restated.

Revenue is recognized upon transfer of control of promised goods or services to customers in an amount that reflects the consideration the Company expects to receive in exchange for those goods or services. The Company's contracts include various product or services or a combination of both, which are generally capable of being distinct and are accounted for as separate performance obligations. The Company's contracts often contain multiple distinct performance obligations.

The Company estimates the transaction price of a contract based on the expected value for which a significant reversal of revenue is not expected to occur. The estimate of the variable consideration is based on the assessment of historical, current, and forecasted performance noted and expected from the performance obligation.

In a multiple element arrangement, the estimated transaction price of each contract is allocated to each distinct performance obligation based on a relative stand-alone selling price ("SSP"). For performance obligations routinely sold separately, the SSP is determined by evaluating such stand-alone sales. For those performance obligations that are not routinely sold separately, the Company determines SSP based on market conditions and other observable inputs.

When the Company sells third-party goods and services, it evaluates whether the Company is the principal, and reports revenues on a gross basis, or an agent, and reports revenues on a net basis. In this assessment, the Company considers if it obtains control of the specified goods or services before they are transferred to the customer, as well as other indicators such as the party primarily responsible for fulfillment, inventory risk, and discretion in establishing price.

Revenue is recorded net of taxes collected from customers which are subsequently remitted to the relevant government authority. The Company does not have any capitalized costs associated with contract acquisition because most direct contract acquisition costs relate to contracts that are recognized over a period of one year or less. Sales commissions are included in "Sales and marketing" expenses in the consolidated statements of operations.

Nature of Products and Services

Platform segment:

The Company generates platform revenue from the sale of digital advertising and related services, content distribution services, subscription and transaction revenue shares, Premium Subscriptions, billing services, sale of branded channel buttons on remote controls and licensing arrangements with service operators and TV brands.

The Company sells digital advertising directly to marketers or through advertising agencies. Revenue from advertising is mostly generated through video and display advertising delivered through advertising impressions. Advertising is typically sold on a cost-per-thousand ("CPM") basis and is evidenced by an Insertion Order, ("IO"). Revenue is recognized as the number of impressions are delivered. IOs may include multiple performance obligations as they contain distinct advertising products or services. For such arrangements, the Company allocates revenue to each distinct performance obligation based on their relative SSP. The Company also generates revenue from customers using its platform. For that it charges a platform fee, which is a percentage of a customer's advertising inventory spend during the month, along with data and any add-on features purchased through the platform. Advertising arrangements comprised of multiple performance obligations are recognized either at a point in time or over time depending on the nature of the distinct performance obligation.

The Company's content distribution revenue sharing arrangements include cash or non-cash consideration. The revenue sharing arrangements generally apply to new subscriptions for accounts that sign up for new services and at the time of a movie rental or purchase. Revenue is recognized on a net basis as the Company is deemed to be the agent between content publishers and end users. Revenue is recognized on a time elapsed basis, by day, as the services are delivered over the contractual distribution term. Non-cash consideration is usually in the form of advertising inventory, the SSP of which is determined based on relevant internal and third-party data.

The Company sells monthly subscriptions for premium content on The Roku Channel for varying fees for different content. Revenue from such premium subscription fees is recognized on a gross basis over the service period as the Company is deemed to be the principal in the relationship with the end user. The Company obtains control of the content before transferring to the end user and has latitude in establishing pricing. The Company pays fixed fees to the providers of premium content on The Roku Channel based on the contractual arrangement and recognizes that as direct cost.

The Company sells branded channel buttons on remote controls of streaming devices that provide one-touch access to a publishers' content. The Company typically receives a fixed fee per button for each unit sold over a defined distribution period. Revenue is recognized on a time elapsed basis, by day, over the distribution term.

The Company licenses the Roku OS, including updates and upgrades, to TV brands and service operators. The licensing revenue is recognized at a point in time, when the Company makes the intellectual property available and the control transfers to the customer. The revenue allocated to unspecified upgrades is recognized on a time elapsed basis, by day, over the service period. Professional services revenue is recognized as services are provided or accepted. Hosting fees are recognized on a time elapsed basis, by day, over the service period. Arrangements may also include marketing development funds paid to TV brands, which are reflected as a reduction to the estimated transaction price.

Player segment:

The Company sells the majority of its players and audio products through retail distribution channels in the U.S., including brick and mortar and online retailers, as well as through the Company's website. Player revenue primarily consists of hardware, embedded software and unspecified upgrades on a when and if-available basis. The hardware and embedded software are considered as one performance obligation and revenue is recognized at a point in time when the control transfers to the customer. Unspecified upgrades or enhancements are available to customers on a when-and-if available basis. The Company records the allocated value of the unspecified upgrades as deferred revenue and recognizes it as player revenue ratably on a time elapsed basis over the estimated economic life of the associated players.

The Company's player revenue includes allowances for returns and sales incentives in the estimated transaction price. These estimates are based on historical experience and anticipated performance. Shipping charges billed to customers are included in revenue and the related shipping costs are included in cost of revenue.

Revenue disaggregation:

The Company's disaggregated revenues are represented by the two reportable segments discussed in Note 17. The disaggregation is based on the evaluations that are regularly performed by the chief operating decision maker ("CODM") for purposes of allocating resources and evaluating financial performance. The Company's CODM is its Chief Executive Officer.

Contract balances:

Contract balances include the following (in thousands):

	<i>As of December 31,</i>	
	<i>2019</i>	<i>2018</i>
Accounts receivable, net	\$ 332,673	\$ 183,078
Contract assets (included in Prepaid expenses and other current assets)	3,588	753
Deferred revenue, current portion	39,861	45,442
Deferred revenue, non-current portion	15,370	19,594
Total deferred revenue	<u>\$ 55,231</u>	<u>\$ 65,036</u>

Accounts receivable are recorded at the amount invoiced, net of an allowance for doubtful accounts, sales returns, and sales incentives. Payment terms can vary by customer and contract.

The timing of revenue recognition may differ from the timing of invoicing to customers. Contract assets are created when invoicing occurs subsequent to revenue recognition. Contract assets are transferred to accounts receivable when the right to invoice becomes unconditional. The Company's contract assets are generally current in nature and are included in "Prepaid expenses and other current assets." Contract assets increased by approximately \$2.8 million during the year ended December 31, 2019 primarily due to an increase in the growth of platform revenue combined with the timing of billing which falls into a subsequent period. Contract assets decreased by

approximately \$3.4 million during the year ended December 31, 2018 as the Company received the right to bill customers subsequent to revenue recognition.

Contract liabilities are included in deferred revenue and reflect consideration invoiced prior to the completion of performance obligations and revenue recognition. Deferred revenue decreased by approximately \$9.8 million during the year ended December 31, 2019 primarily due to revenue recognized of \$5.0 million pursuant to customer acceptance of a milestone, and the remaining revenue recognized primarily relates to the timing of fulfillment of performance obligations. Deferred revenue increased by approximately \$10.1 million during the year ended December 31, 2018 primarily due to the overall growth of the business.

Revenue recognized during the year ended December 31, 2019 from amounts included in deferred revenue as of December 31, 2018 was \$52.5 million. Revenue recognized during the year ended December 31, 2018 from amounts included in deferred revenue as of January 1, 2018 was \$38.5 million.

Revenue Allocated to Future Performance Obligations:

Revenue allocated to remaining performance obligations represents estimated contracted revenue that has not yet been recognized which includes unearned revenue and amounts that will be invoiced and recognized as revenue in future periods. Estimated contracted revenue was \$161.1 million as of December 31, 2019 of which the Company expects to recognize approximately 54% over the next 12 months and the remainder thereafter.

4. BUSINESS COMBINATION

On November 8, 2019, the Company acquired all outstanding shares of dataxu, Inc., ("dataxu") according to the terms and conditions of the Agreement and Plan of Merger, dated as of October 22, 2019 (the "Merger Agreement"). dataxu is a demand-side platform ("DSP") that enables marketers to plan and buy video ad campaigns. The acquisition of dataxu's platform complements the Company's OTT advertising platform and enables marketers to access a single, data-driven software solution to plan, buy, and optimize their ad spend across TV and OTT providers.

The total purchase consideration for dataxu was \$148.4 million, which consisted of \$78.7 million in cash and \$69.7 million for the fair value of the Company's 571,459 shares of common stock. Pursuant to the Merger Agreement, the Company deposited \$18.8 million into an escrow account to secure certain indemnifications and other potential obligations. Of this \$18.8 million, \$17.5 million is included in the purchase consideration. The remaining amount is not considered part of the purchase consideration as it is utilized for post combination related activities by the Company and are recorded in general and administrative expenses in the consolidated statement of operations.

The total purchase consideration includes \$1.8 million contingent consideration, carrying value of which approximates its fair value due to its short-term nature. This contingent consideration is included in the escrow amount and may be transferred to dataxu shareholders if certain conditions set forth in the Merger Agreement are met.

The Company incurred \$3.9 million in acquisition related expenses and has recorded them in general and administrative expenses in the consolidated statement of operations.

Purchase Price Allocation

The preliminary allocation of the purchase consideration to tangible and intangible assets acquired and liabilities assumed is based on estimated fair values and is as follows (in thousands):

Assets acquired		
Current assets	\$	50,829
Restricted cash		1,303
Property and equipment, net		4,503
Intangible assets		70,200
Goodwill		72,733
Operating lease right-of-use assets		24,658
Other long-term assets		235
Total assets acquired		<u>224,461</u>
Liabilities assumed		
Current liabilities		(51,428)
Operating lease liabilities		(24,658)
Total liabilities assumed		<u>(76,086)</u>
Total preliminary purchase consideration	\$	<u>148,375</u>

The preliminary fair value estimates of the net assets acquired are based upon preliminary calculations and valuations, and those estimates and assumptions regarding certain tangible assets acquired and liabilities assumed, the valuation of intangible assets acquired, income taxes, and goodwill are subject to change as the Company obtains additional information during the measurement period (up to one year from the acquisition date). The excess of the total consideration over the tangible assets, identifiable intangible assets, and assumed liabilities is recorded as goodwill. Goodwill is primarily attributable to expected synergies in our advertising offerings and cross-selling opportunities.

Identifiable Intangible Assets

The identifiable intangible assets acquired consisted of developed technology, customer relationships and tradename with estimated useful lives of 6 months to 6 years. The Company amortizes the fair value of these intangible assets on a straight-line basis over their respective useful lives.

The fair value of the intangible assets has been estimated using the income approach in which the after-tax cash flows are discounted to present value. The key valuation assumptions include the Company's estimates of revenue growth projections and discount rates. The valuation of the intangible assets acquired from dataxu along with their estimated useful lives, is as follows (in thousands):

	Estimated Fair Value	Estimated Useful Lives (in years)
Developed technology	\$ 56,400	6.0
Customer relationships	13,400	4.0
Tradename	400	0.5
Estimated fair value of acquired intangible assets	<u>\$ 70,200</u>	

Taxes

The goodwill recorded is not deductible for tax purposes. In connection with the acquisition, a deferred tax liability is established for the book/tax differences related to non-goodwill intangible assets. The deferred tax liability is not reflected as the Company also acquired deferred tax assets, including significant net operating losses, that offset the deferred tax liability. Additionally, both companies have full valuation allowances recorded against their respective deferred tax assets, resulting in a net zero adjustment to deferred taxes on the consolidated balance sheet.

Unaudited Pro Forma Results

The unaudited pro forma financial information in the table below summarizes the combined results of operations for Roku and dataxu, as if the companies were combined as of the beginning of fiscal 2018.

The unaudited pro forma financial information for all periods presented included the business combination accounting effects resulting from this acquisition, mainly including adjustments to reflect the adoption of ASC 842 and ASC 606, additional amortization expense from acquired intangible assets, additional stock-based compensation expense, elimination of historical interest expense associated with dataxu's historical convertible notes and indebtedness and the related tax effects as though dataxu was combined as of the beginning of fiscal 2018. The unaudited pro forma financial information as presented below is for informational purposes only and is not necessarily indicative of the results of operations that would have been achieved if the acquisitions had taken place at the beginning of fiscal 2018.

The unaudited pro forma financial information for fiscal 2019 combines the Company's financial results for fiscal 2019 and the historical results of dataxu for fiscal 2019 up to the date it was acquired by the Company. The unaudited pro forma financial information for fiscal 2018 combines the historical results of the Company and dataxu for their respective year ended December 31, 2018. Both years include the effects of the pro forma adjustments listed above.

The unaudited pro forma financial information was as follows (in thousands):

	For the Year Ended December 31,	
	2019	2018
Total Revenues	\$ 1,218,403	\$ 884,286
Pretax loss	(87,654)	(39,919)
Net loss	(86,791)	(39,670)

The Company recorded \$16.8 million in revenue, \$10.2 million in cost of revenue and \$6.6 in gross profit in the Company's consolidated statement of operations from the acquisition date of November 8, 2019 to December 31, 2019.

5. GOODWILL AND INTANGIBLE ASSETS*Goodwill*

Goodwill represents the excess of purchase consideration in a business combination over the fair value of tangible and intangible assets acquired net of the liabilities assumed. During the year ended December 31, 2019, the Company recorded goodwill of \$72.7 from the dataxu acquisition. Goodwill recorded from the dataxu acquisition relates to the Company's platform segment. The goodwill is evaluated for impairment annually. No impairment was recognized during the years ended December 31, 2019, 2018 and 2017.

Intangible Assets

The following table is the summary of Company's intangible assets (in thousands):

	As of December 31, 2019			
	Gross Carrying Amount	Accumulated Amortization	Net Carrying Amount	Weighted-Average Useful Lives (in years)
Developed technology	\$ 62,367	\$ (2,860)	\$ 59,507	5.9
Customer relationships	13,400	(558)	12,842	4.0
Tradename	400	(133)	267	0.5
Patents	4,076	(24)	4,052	14.0
Intangible assets	<u>\$ 80,243</u>	<u>\$ (3,575)</u>	<u>\$ 76,668</u>	

	As of December 31, 2018			
	Gross Carrying Amount	Accumulated Amortization	Net Carrying Amount	Weighted-Average Useful Lives (in years)
Developed technology	\$ 2,215	\$ (738)	\$ 1,477	4.0
Intangible assets	<u>\$ 2,215</u>	<u>\$ (738)</u>	<u>\$ 1,477</u>	

During the year ended December 31, 2019, the Company acquired \$70.2 million of developed technology, customer relationships, and tradename as a part of the dataxu acquisition. Additionally, during the year ended December 31, 2019, the Company acquired \$4.1 million of patents and \$3.8 million of developed technology in form of asset acquisitions.

The Company recorded expenses of \$2.8 million, \$0.6 million and \$0.2 million for amortization of intangible assets during the years ended December 31, 2019, 2018 and 2017, respectively. In the year ended December 31, 2019, the Company recorded amortization of developed technology in cost of revenue, platform, cost of revenue, player, research and development, and general and administrative expenses in the consolidated statement of operations and recorded amortization of customer relationships and tradename in sales and marketing expenses in the consolidated statement of operations. In the years ended December 31, 2018 and 2017, the Company recorded amortization of developed technology on research and development expenses in the consolidated statement of operations.

The estimated future amortization expense for intangible asset for the next five years and thereafter is as follows (in thousands):

Year Ending December 31,	
2020	\$ 14,487
2021	14,036
2022	13,666
2023	13,108
2024	10,316
Thereafter	11,055
Total	<u>\$ 76,668</u>

6. BALANCE SHEET COMPONENTS

Accounts Receivable, net: Accounts receivable, net consisted of the following (in thousands):

	As of December 31,	
	2019	2018
Gross accounts receivable	\$ 360,194	\$ 204,975
Allowance for sales returns	(6,550)	(7,335)
Allowance for sales incentives	(19,476)	(13,750)
Other allowances	(1,495)	(812)
Total allowances	<u>(27,521)</u>	<u>(21,897)</u>
Total Accounts Receivable—net of allowances	<u>\$ 332,673</u>	<u>\$ 183,078</u>

Allowance for Sales Returns: Allowance for sales returns consist of the following activities (in thousands):

	As of December 31,	
	2019	2018
Beginning balance	\$ (7,335)	\$ (6,907)
Charged to revenue	(15,541)	(17,396)

Utilization of sales return reserve	16,326	16,968
Ending balance	<u>\$ (6,550)</u>	<u>\$ (7,335)</u>

Allowance for Sales Incentive: Allowance for sales incentive consisted of the following activities (in thousands):

	As of December 31,	
	2019	2018
Beginning balance	\$ (13,750)	\$ (10,442)
Charged to revenue	(65,676)	(50,958)
Utilization of sales incentive reserve	59,950	47,650
Ending balance	<u>\$ (19,476)</u>	<u>\$ (13,750)</u>

Property and Equipment, net: Property and equipment, net consisted of the following (in thousands):

	As of December 31,	
	2019	2018
Computers and equipment	\$ 23,834	\$ 16,056
Leasehold improvements	93,239	18,396
Website and internal-use software	6,510	6,423
Office equipment and furniture	12,091	4,069
Total property and equipment	135,674	44,944
Accumulated depreciation and amortization	(32,412)	(19,680)
Property and Equipment, net	<u>\$ 103,262</u>	<u>\$ 25,264</u>

Depreciation and amortization expense, for property and equipment assets, for the years ended December 31, 2019, 2018 and 2017 was \$12.8 million, \$7.8 million and \$5.2 million, respectively.

Accrued Liabilities: Accrued liabilities consisted of the following (in thousands):

	As of December 31,	
	2019	2018
Payments due to content publishers	\$ 57,376	\$ 32,463
Accrued cost of revenue	58,149	22,830
Operating lease liability, current	17,896	—
Accrued royalty expense	18,040	7,939
Accrued payroll and related expenses	14,522	12,217
Accrued inventory	2,892	6,008
Marketing, retail and merchandising costs	7,624	—
Accrued legal expenses	3,158	—
Customer prepayments	2,669	3,124
Taxes and related liabilities	3,052	1,314
Other accrued expenses	12,969	6,091
Total Accrued Liabilities	<u>\$ 198,347</u>	<u>\$ 91,986</u>

Deferred Revenue: Deferred revenue consisted of the following (in thousands):

	As of December 31,	
	2019	2018
Platform, current	\$ 18,234	\$ 28,569
Player, current	21,627	16,873
Total deferred revenue, current	39,861	45,442
Platform, non-current	6,135	12,783
Player, non-current	9,235	6,811
Total deferred revenue, non-current	15,370	19,594
Total Deferred Revenue	\$ 55,231	\$ 65,036

7. SHORT-TERM INVESTMENTS

The Company did not have any short-term investments as of December 31, 2019. The following is a summary of the Company's short-term investments as of December 31, 2018 (in thousands):

	As of December 31, 2018			
	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Loss	Fair Value
Corporate bonds and commercial paper	\$ 37,168	\$ —	\$ (17)	\$ 37,151
U.S. government securities	4,995	—	—	4,995
Total Short-Term Investments	\$ 42,163	\$ —	\$ (17)	\$ 42,146

The following table summarizes the maturities of the Company's short-term investments by contractual maturity (in thousands):

	As of December 31, 2018	
	Amortized Cost	Fair Value
Less than 1 year	\$ 42,163	\$ 42,146
Due in 1-3 years	—	—
Total Short-Term Investments	\$ 42,163	\$ 42,146

8. FAIR VALUE DISCLOSURE

The Company's financial assets measured at fair value are as follows (in thousands):

	As of December 31, 2019			As of December 31, 2018		
	Fair Value	Level 1	Level 2	Fair Value	Level 1	Level 2
Assets:						
Cash and cash equivalents:						
Cash	\$ 463,820	\$ 463,820	\$ —	\$ 147,221	\$ 147,221	\$ —
Money market funds	51,659	51,659	—	8,343	8,343	—
Restricted cash	1,854	1,854	—	—	—	—
Short-term investments:						
Corporate bonds and commercial paper	—	—	—	37,151	—	37,151
U.S. government securities	—	—	—	4,995	—	4,995
Total assets measured and recorded at fair value	\$ 517,333	\$ 517,333	\$ —	\$ 197,710	\$ 155,564	\$ 42,146

Fair value is defined as the price that would be received to sell an asset or paid to transfer a liability in the principal market (or most advantageous market, in the absence of a principal market) for the asset or liability in an orderly transaction between market participants at the measurement date. Further, the Company maximizes the use of observable inputs and minimizes the use of unobservable inputs in measuring fair value, and to utilize a three-level fair value hierarchy that prioritizes the inputs used to measure fair value. The three levels of inputs used to measure fair value are as follows:

Level 1—Quoted prices in active markets for identical assets or liabilities.

Financial assets and liabilities measured using Level 1 inputs include cash equivalents, accounts receivable, prepaid expenses, accounts payable and accrued liabilities.

The Company considers all highly liquid investments purchased with an original or remaining maturity of 90 days or less at the date of purchase to be cash equivalents. The Company measured money market funds of \$51.7 million and \$8.3 million as cash equivalents as of December 31, 2019 and 2018, respectively, using Level 1 inputs.

Level 2—Observable inputs other than quoted prices included within Level 1, including quoted prices for similar assets or liabilities in active markets; quoted prices for identical or similar assets or liabilities in markets that are not active; and inputs other than quoted prices that are observable or are derived principally from, or corroborated by, observable market data by correlation or other means.

The Company measured its short-term investments using Level 2 inputs.

Level 3—Unobservable inputs that are supported by little or no market activity, are significant to the fair value of the assets or liabilities and reflect the Company's own assumptions about the assumptions market participants would use in pricing the asset or liability developed based on the best information available in the circumstances.

The Company did not have Level 3 instruments at December 31, 2019 and 2018. During the year ended December 31, 2017, Level 3 instruments consisted of the Company's convertible preferred stock warrant liability. Pursuant to the Company's IPO in October 2017, all convertible preferred stock warrants were converted into Class B common stock warrants, which did not require further re-measurements as they were deemed permanent equity. For periods prior to the IPO, the Company's convertible preferred stock warrant liability was measured at fair value upon issuance and at each reporting date prior to the IPO. The inputs that were used to determine the estimated fair value of the convertible preferred stock warrant liability included the remaining contractual term of the warrants, the risk-free interest rate, the volatility of comparable public companies over the remaining term, and the fair value of underlying shares. The significant unobservable inputs used in the fair value measurement of the convertible preferred stock warrant liability were the fair value of the underlying stock at the valuation date and the estimated term of the warrants.

The following table represents the activity of Level 3 instruments (in thousands):

	Year Ended December 31, 2017
Convertible preferred stock warrant liability — beginning balance	\$ 9,990
Fair value of new warrants issued	2,032
Change in fair value of preferred stock warrant liability*	40,333
Reclassification to additional paid in capital upon conversion to common warrants	(52,355)
Convertible preferred stock warrant liability — ending balance	\$ —

* Recognized in the consolidated statements of operations within other income (expense), net.

Assets and liabilities that are measured at fair value on a non-recurring basis

Non-financial assets such as goodwill, intangible assets, property, plant, and equipment and operating lease right-of-use assets are evaluated for impairment and adjusted to fair value using Level 3 inputs, only when impairment is recognized. The Company recorded an impairment of \$0.9 million for operating lease right-of-use assets and \$0.4 million for long-lived assets that were no longer in use during the years ended December 31, 2019 and 2018, respectively. There were no indicators of impairment that required a fair value analysis during the year ended December 31, 2017.

9. LEASES

The Company determines if an arrangement contains a lease at its inception. Operating leases are included in operating lease right-of-use (“ROU”) assets, accrued liabilities, and operating lease liability in our consolidated balance sheets. ROU assets represent the Company’s right to use an underlying asset for the lease term and lease liabilities represent its obligation to make lease payments arising from the lease. ROU assets and liabilities are recognized at commencement date based on the present value of lease payments over the lease term. As the rate implicit in the lease is not readily determinable, the Company uses its incremental borrowing rate based on the information available at the commencement date in determining the present value of future lease payments. The Company took into consideration its credit rating and the length of the lease when calculating the incremental borrowing rate. The Company considers the options to extend or terminate the lease in determining the lease term, when it is reasonably certain to exercise one of the options. The Company combines lease and non-lease components into a single lease component for its real estate and equipment leases.

The Company has entered into operating leases primarily for office real estate. The leases have remaining terms ranging from one year to 11 years and may include options to extend or terminate the lease. The depreciable life of ROU assets is limited by the expected lease term.

The Company earns sublease income from subleases for a portion of the former headquarters in Saratoga, California. The subleases expire in 2020 when the underlying leases expire.

The components of lease expense are as follows (in thousands):

	Year Ended December 31, 2019
Operating lease cost	\$ 30,218
Sublease income	(2,622)
Net operating lease cost	\$ 27,596

Supplemental cash flow information related to leases is as follows (in thousands):

	Year Ended December 31, 2019
Cash paid for amounts included in the measurement of lease liabilities:	
Operating cash outflows from operating leases	\$ 17,721
Right-of-use assets obtained in exchange for lease obligations:	
Operating leases	\$ 267,048

Supplemental balance sheet information related to leases was as follows (in thousands, except lease term and discount rate):

	As of December 31, 2019
Operating lease right-of-use assets	\$ 283,291
Included in accounts payable and accrued liabilities:	
Operating lease liability, current	17,896
Operating lease liability, non-current	301,694
Total operating lease liability	\$ 319,590
Weighted Average Remaining Lease Term:	
Operating leases (in years)	9.98
Weighted Average Discount Rate:	
Operating leases	4.65%

Future lease payments under operating leases as of December 31, 2019 were as follows (in thousands):

Year Ending December 31,	Operating Leases
2020	\$ 29,230
2021	47,035
2022	43,909
2023	44,655
2024	44,014
Thereafter	246,488
Total future lease payments	455,331
Less: imputed interest	(95,762)
Less: expected tenant improvement allowance	(39,979)
Total	\$ 319,590

As of December 31, 2019, the Company has additional operating leases, primarily corporate offices, that have not yet commenced of \$6.6 million. These operating leases will commence in fiscal year 2020 with lease terms of 5 years to 11 years.

The following table summarizes the future minimum lease payments due under operating leases as of December 31, 2018 and reflect the application of the prior lease standard (ASC 840, Leases). These amounts were disclosed in the Company's Annual Report on Form 10-K for the year ended December 31, 2018 (in thousands):

Year Ending December 31,	Operating Leases
2019	\$ 16,817
2020	29,124
2021	32,034
2022	32,844
2023	33,414
Thereafter	223,472
Less: sublease income	(3,711)
Total	<u>\$ 363,994</u>

Rent expense, under ASC 840, for the years ended December 31, 2018 and 2017 was \$9.7 million and \$6.9 million, respectively.

10. DEBT

The Company's outstanding debt as of December 31, 2019 is as follows (in thousands):

	As of December 31, 2019	
	Amount	Effective Interest Rate
Term Loan A Facility	\$ 100,000	3.48%
Less: Debt issuance costs	(392)	
Net carrying amount of debt	<u>\$ 99,608</u>	

The carrying amount of debt approximates fair value due to its variable interest rates. The Company did not have any outstanding debt as of December 31, 2018.

The following table sets forth the Company's interest expense recognized in relation to the debt (in thousands):

	Year Ended December 31, 2019
Contractual interest expenses related to Term Loan A Facility	\$ 420
Amortization of debt issuance costs	11
Total interest expense	<u>\$ 431</u>

Senior Secured Term Loan A and Revolving Credit Facilities

On February 19, 2019 (the "Original Closing Date"), the Company entered into a Credit Agreement (the "Existing Credit Agreement") with Morgan Stanley Senior Funding, Inc. On May 3, 2019, (the "Closing Date"), the Existing Credit Agreement was amended pursuant to an Incremental Assumption and Amendment No. 1 (the "Amendment" and the Existing Credit Agreement as amended by the Amendment, the "Credit Agreement"). On the Original Closing Date, the Company terminated its Restated 2014 LSA (as defined below) with Silicon Valley Bank.

The Credit Agreement provides for (i) a four-year revolving credit facility in the aggregate principal amount of up to \$100.0 million (the "Revolving Credit Facility"), (ii) a four-year delayed draw term loan A facility in the aggregate principal amount of up to \$100.0 million (the "Term Loan A Facility") and (iii) an uncommitted incremental facility, subject to the satisfaction of certain financial and other conditions, in the amount of up to (v) \$50.0 million, plus (w) 1.0x of the Company's EBITDA for the most recently completed four fiscal quarter period, plus (x) an additional amount at the Company's discretion, so long as, on a pro forma basis at the time of incurrence, the Company's secured leverage ratio does not exceed 1.50 to 1.00, plus (y) voluntary prepayments of the Revolving Credit Facility and Term Loan A Facility to the extent accompanied by concurrent reductions to the applicable

Credit Facility (together with the Revolving Credit Facility and the Term Loan A Facility, collectively, the "Credit Facility").

On November 18, 2019, the Company drew from the Term Loan A facility in the aggregate principal amount of \$100.0 million and elected a Eurodollar borrowing with interest at a rate equal to the adjusted one-month LIBOR rate plus an applicable margin of 1.75% based on the Company's secured leverage ratio.

Loans under the Term Loan A Facility will amortize in equal quarterly installments beginning on March 31, 2020, in an aggregate annual amount equal to (i) on or prior to December 31, 2021, 1.25% of the drawn principal amount of the Term Loan Facility or \$1.25 million and (ii) thereafter, 2.50% of the drawn principal amount of the Term Loan Facility or \$2.5 million, with the remaining balance payable on the maturity date of the Term Loan A Facility in February 2023.

The Company did not have any borrowings outstanding on the Revolving Credit Facility as of December 31, 2019. The Company had outstanding letters of credit as of December 31, 2019, totaling \$30.7 million, which reduced the balance available to draw on the Revolving Credit Facility from \$100.0 million to \$69.3 million.

The Company's obligations under the Credit Agreement are secured by substantially all of its assets. In the future, certain of its direct and indirect subsidiaries may be required to guarantee the Credit Agreement. The Company may prepay, and in circumstances is required to prepay, loans under the Credit Agreement without payment of a premium. The Credit Agreement contains customary representations and warranties, customary affirmative and negative covenants, a financial covenant that is tested quarterly and requires the Company to maintain a certain adjusted quick ratio of at least 1.00 to 1.00, and customary events of default.

As of December 31, 2019, the Company is in compliance with all the covenants of the Credit Agreement.

Line of Credit with Silicon Valley Bank

The Company entered into a loan and security agreement (the "LSA") with Silicon Valley Bank in July 2011. The LSA was amended and restated in subsequent periods. The amended and restated loan and security agreement (the "Restated 2014 LSA") entered into in November 2014 provided advances under a revolving line of credit up to \$30.0 million and provided for letters of credit to be issued up to \$5.0 million.

In June 2017, the Company entered into a second amendment to the Restated 2014 LSA (such amendment, the "Second Amendment"). Advances under the Second Amendment carry a floating per annum interest rate equal to, at the Company's option, (1) the prime rate or (2) LIBOR plus 2.75%, or the prime rate plus 1% depending on certain ratios. The Second Amendment further changed the financial covenant to maintain a current ratio (calculated as current assets, divided by current liabilities less deferred revenue) greater than or equal to 1.25. As of December 31, 2018, the Company was in compliance with all of the covenants in the amended Restated 2014 LSA.

On July 18, 2018, the Company entered into a third amendment to the Restated 2014 LSA (such amendment, the "Third Amendment"). The Third Amendment increased the amount by which the Company could utilize its line of credit to support the issuances of letters of credits from \$5.0 million to \$30.0 million.

On February 19, 2019, the Company terminated the Restated 2014 LSA agreement with Silicon Valley Bank.

11. STOCKHOLDERS' EQUITY

Preferred Stock

The Company has 10 million shares of undesignated preferred stock authorized but not issued with rights and preferences determined by the Company's Board of Directors at the time of issuance of such shares. As of December 31, 2019 and 2018, there were no shares of preferred stock issued and outstanding.

Common Stock

The Company has two classes of authorized common stock, Class A common stock and Class B common stock. Holders of Class A common stock are entitled to one vote for each share of Class A common stock held on all matters submitted to a vote of stockholders and holders of Class B common stock are entitled to ten votes for each share of Class B common stock held on all matters submitted to a vote of stockholders. Except with respect to voting, the rights of the holders of Class A and Class B common stock are identical. Shares of Class B common stock are voluntarily convertible into shares of Class A common stock at the option of the holder and are generally automatically converted into shares of the Company's Class A common stock upon sale or transfer. Shares issued in connection with exercises of stock options, vesting of restricted stock units, or shares purchased under the employee stock purchase plan are generally automatically converted into shares of the Company's Class A common stock. Shares issued in connection with an exercise of the common stock warrants are converted into shares of the Company's Class B common stock.

At-the-Market Offerings

On March 12, 2019, the Company entered into an Equity Distribution Agreement with Citigroup Global Markets Inc., as its sales agent (the "Citi Equity Distribution Agreement"), pursuant to which the Company could issue and sell from time-to-time shares of its Class A common stock for aggregate gross proceeds of up to \$100.0 million. In March 2019, the Company sold approximately 1.4 million shares of Class A common stock at an average selling price of \$72.00 per share, constituting all available shares for sale under the Citi Equity Distribution Agreement for aggregate gross proceeds of \$100.0 million and incurred issuance costs of \$2.0 million.

On May 16, 2019, the Company entered into an Equity Distribution Agreement with Morgan Stanley & Co. LLC, as its sales agent (the "MS Equity Distribution Agreement"), pursuant to which the Company could issue and sell up to an aggregate of 1.0 million shares of its Class A common stock. In May 2019, the Company sold all 1.0 million available shares for sale under the MS Equity Distribution Agreement at an average selling price of \$82.90 per share, for aggregate gross proceeds of \$82.9 million and incurred issuance costs of \$1.6 million.

On November 19, 2019, the Company entered into another Equity Distribution Agreement with Citigroup Global Markets Inc. as its sales agent (the "Citi Equity Distribution Agreement – 2"), pursuant to which the Company could issue and sell from time-to-time up to an aggregate of 1.0 million shares of its Class A common stock. In November 2019, the Company sold all 1.0 million shares available for sale under the Citi Equity Distribution Agreement – 2 at an average selling price of \$153.99 per share for aggregate gross proceeds of \$153.99 million and incurred issuance costs of \$2.8 million.

Common Stock Reserved For Issuance

At December 31, 2019, the Company had reserved shares of common stock for issuance as follows (in thousands):

	<u>As of December 31, 2019</u>
Common stock awards granted under equity incentive plans	15,668
Common stock awards available for issuance under the 2017 Employee Stock Purchase Plan *	2,089
Common stock awards available for issuance under the 2017 Equity Incentive Plan	16,950
Total reserved shares of common stock	<u>34,707</u>

* The Company has not issued any common stock pursuant to the 2017 Employee Stock Purchase Plan.

Equity Incentive Plans

The Company has two equity incentive plans, the 2008 Equity Incentive Plan (the “2008 Plan”) and the 2017 Equity Incentive Plan (the “2017 Plan”). The 2017 Plan became effective September 2017 in connection with the IPO. No further shares have been issued under the 2008 Plan. The 2017 Plan provides for the grant of incentive stock options to the Company’s employees and for the grant of non-statutory stock options, stock appreciation rights, restricted stock awards, restricted stock unit awards, performance stock awards, performance cash awards, and other forms of equity compensation to the Company’s employees, directors and consultants.

Restricted stock units granted under the plan are subject to continuous service. Options granted under the plans are granted at a price per share equivalent to the fair market value on the date of grant. Recipients of option grants who possess more than 10% of the combined voting power of the Company (a “10% Shareholder”) are subject to certain limitations, and incentive stock options granted to such recipients are at a price no less than 110% of the fair market value at the date of grant.

Restricted Stock Units

Restricted stock unit activity for the year ended December 31, 2019 is as follows (in thousands, except per share data):

	Number of Shares	Weighted Average Grant Date Fair Value Per Share
Balance, December 31, 2018	3,686	\$ 48.50
Awarded	2,228	87.60
Released	(822)	49.26
Forfeited	(548)	50.40
Balance, December 31, 2019 - outstanding	4,544	\$ 67.30

The grant-date fair value of restricted stock units granted during the year ended December 31, 2019 was \$195.2 million. Total unrecognized compensation cost related to restricted stock units awarded to employees as of December 31, 2019 was \$267.7 million, which the Company expects to recognize over 2.77 years. The intrinsic value of restricted stock units that vested in the years ended December 31, 2019 and 2018 was \$100.1 million and \$12.7 million, respectively, which represented the fair value of the Company’s common stock underlying the restricted stock units on their vesting date.

Stock options

The following table summarizes the Company’s stock option activities under the 2008 Plan and 2017 Plan (in thousands, except per share data):

	Number of Shares	Weighted Average Exercise Price	Weighted Average Remaining Contractual Life (Years)	Weighted Average Grant Date Fair Value Per Share	Aggregate Intrinsic Value
Balance, December 31, 2018	16,371	\$ 8.59	6.8	—	
Granted	572	100.06	—	\$ 39.23	
Exercised	(5,352)	5.35	—	—	
Forfeited and expired	(467)	8.77	—	—	
Balance, December 31, 2019 - outstanding	11,124	\$ 14.84	6.2	—	\$ 1,324,461
Options exercisable at December 31, 2019	6,603	\$ 5.84	5.1	—	\$ 845,590

The weighted average grant-date fair value of stock options granted during the years ended December 31, 2019, 2018 and 2017 was \$39.23, \$22.96 and \$3.73, respectively. The total intrinsic value of stock options exercised in the years ended December 31, 2019, 2018 and 2017 was \$474.2 million, \$445.9 million and \$20.4 million, respectively, and represents the difference between the fair value of the Company's common stock at the dates of exercise and the exercise price of the options. As of December 31, 2019, the Company had \$41.2 million of unrecognized stock compensation expense related to unvested stock options that is expected to be recognized over a weighted-average period of approximately 1.78 years.

Stock-based Compensation

The Company measures the cost of employee services received in exchange for an equity award based on the grant date fair value of the award. Generally, stock options granted to employees vest 25% after one year and then 1/48th monthly thereafter and have a term of ten years, and restricted stock units issued generally vest 25% after one year and then 1/16th quarterly thereafter.

The following table shows total stock-based compensation expense included in the accompanying Consolidated Statements of Operations for the years ended December 31, 2019, 2018 and 2017 (in thousands):

	Years Ended December 31,		
	2019	2018	2017
Cost of platform revenue	\$ 342	\$ 97	\$ 81
Cost of player revenue	1,072	469	145
Research and development	40,036	18,538	4,714
Sales and marketing	24,179	10,459	2,817
General and administrative	19,546	8,111	3,196
Total stock-based compensation	<u>\$ 85,175</u>	<u>\$ 37,674</u>	<u>\$ 10,953</u>

The fair value of options granted under the 2008 Plan and 2017 Plan is estimated on the grant date using the Black-Scholes option-valuation model. This valuation model for stock-based compensation expense requires the Company to make certain assumptions and judgments about the variables used in the calculation, including the expected term, the expected volatility of the Company's common stock, an assumed risk-free interest rate, and expected dividends. The Company recognizes forfeitures as they occur.

Fair Value of Common Stock: Prior to our IPO, the fair value of the common stock underlying our stock options was determined by our Board of Directors. The valuations of our common stock were determined in accordance with the guidelines outlined in the American Institute of Certified Public Accountants Practice Aid, Valuation of Privately-Held-Company Equity Securities Issued as Compensation. Our Board of Directors, with input from management, exercised significant judgment and considered numerous objective and subjective factors to determine the fair value of our common stock at each grant date, including but not limited to the prices, rights, preferences and privileges of our preferred stock relative to the common stock, our operating and financial performance, current business conditions and projections, our stage of development, likelihood of achieving a liquidity event for the shares of common stock underlying these stock options, such as an IPO or sale of our company, given prevailing market conditions, any adjustment necessary to recognize a lack of marketability of the common stock underlying the granted options, the market performance of comparable publicly-traded companies, the U.S. and global capital market conditions.

Subsequent to our IPO, the Company uses the market closing price for our Class A common stock as reported on The Nasdaq Global Select Market on the date of grant. The Company uses the straight-line method for expense recognition.

Expected Term: The Company's expected term represents the period that the Company's stock-based awards are expected to be outstanding and is determined based on the simplified method as described in ASC Topic 718-10-S99-1, *SEC Materials SAB Topic 14, Share-Based Payment*.

Expected Volatility: The Company's volatility factor is estimated using several comparable public company volatilities for similar option terms.

Expected Dividends: The Company has never paid cash dividends and has no present intention to pay cash dividends in the future, and as a result, the expected dividends are \$0.

Risk-Free Interest Rate: The Company bases the risk-free interest rate on the implied yield currently available on U.S. Treasury zero coupon issues with a remaining term equivalent to the estimated life of the stock-based awards. Where the expected term of the Company's stock-based awards does not correspond with the term for which an interest rate is quoted, the Company performs a straight-line interpolation to determine the rate from the available term maturities.

The assumptions used to value stock-based awards granted during the years ended December 31, 2019, 2018 and 2017 are as follows:

	Years Ended December 31,		
	2019	2018	2017
Dividend rate	—	—	—
Expected term (in years)	5.0 - 6.7	5.3 - 6.8	5.3 - 6.5
Risk-free interest rate	1.35 - 2.56%	2.32 - 2.88%	1.87 - 2.25%
Expected volatility	35 - 36%	38 - 40%	39 - 44%
Fair value of common stock	—	—	\$2.56 - \$18.46

Stock Warrants

The Company does not have any outstanding warrants as of December 31, 2019 and 2018. In July 2017 the Company issued 0.4 million shares of Class B common stock upon exercise of 0.4 million Class B common stock warrants issued in 2009. Immediately prior to the Company's IPO in 2017, warrants to purchase 2.2 million shares of convertible preferred stock were outstanding. The warrants were automatically converted into warrants to purchase 2.2 million shares of Class B common stock upon the closing of the IPO.

The fair value of the convertible preferred stock warrants was recorded as a liability and was remeasured at the end of each balance sheet date using the Black-Scholes option pricing model. The Company revalued the convertible preferred stock warrants as of the completion of the IPO and reclassified the outstanding preferred stock warrant liability balance to additional paid-in capital with no further re-measurement required as Class B common stock warrants are considered permanent equity. Changes in the fair value of the convertible preferred stock warrants were recognized in the consolidated statements of operations. The Company valued the convertible preferred stock warrants using the following assumptions:

	Year Ended December 31, 2017
Dividend rate	—
Expected term (in years)	3.0 - 9.7
Risk-free interest rate	1.5 - 2.3%
Expected volatility	44 - 51%

After conversion into warrants to purchase shares of Class B common stock, 1.9 million warrants were exercised and 0.1 million shares were cancelled during the year ended December 31, 2017. The warrant agreements allowed for net settlement for Class B common stock. As a result, the Company issued 1.8 million shares of Class B common stock upon exercise.

As of December 31, 2017, warrants to purchase 0.2 million shares of Class B common stock were outstanding, which were exercised during the year ended December 31, 2018.

12. COMMITMENTS AND CONTINGENCIES***Manufacturing Purchase Commitments***

The Company has various manufacturing contracts with vendors in the conduct of the normal course of its business. In order to manage future demand for our products, the Company enters into agreements with manufacturers and suppliers to procure inventory based upon certain criteria and timing. Some of these commitments are non-cancelable. As of December 31, 2019 and 2018, the Company had \$55.7 million and \$40.6 million purchase commitments for inventory, respectively.

The Company records a liability for non-cancelable purchase commitments in excess of projected demand forecasts. The Company recorded \$0.3 million and \$0.1 million for these purchase commitments in "Accrued liabilities" at December 31, 2019 and 2018, respectively.

Content License Purchase Commitments

At December 31, 2019, the Company recorded \$1.7 million as obligations in "Accrued liabilities" for license purchase commitments. The obligations for the year ended December 31, 2018 were not material. As of December 31, 2019, the Company did not have any remaining performance obligations that are not reflected on the financial statements as they do not yet meet the criteria for asset and liability recognition.

Letters of Credit

As of December 31, 2019, the Company had irrevocable letters of credit outstanding in the amount of \$31.8 million for the benefit of landlords related to non-cancelable facilities leases. The letters of credit expire on various dates in 2030.

Contingencies

The Company accrues for loss contingencies, including liabilities for intellectual property licensing claims, when it believes such losses are probable and reasonably estimable. These contingencies are reviewed at least quarterly and adjusted to reflect the impact of negotiations, estimated settlements, legal rulings, advice of legal counsel and other information and events. The resolution of these contingencies and of other legal proceedings can be, however, inherently unpredictable and subject to significant uncertainties.

During the year ended December 31, 2019, the Company recorded expenses of \$9.9 million, in total cost of revenue, for various claims related to patent infringements. The expense includes accruals based on best estimates and are subject to adjustments in the future. During the year ended December 31, 2018, the Company changed its estimate of certain liabilities previously recorded for intellectual property licensing and released \$8.9 million as a result of its assessment that the likelihood of payment is now remote. The reversal of \$8.9 million is recorded within cost of revenue, player during the year ended December 31, 2018, in the consolidated statements of operations.

From time to time, the Company is subject to legal proceedings, claims, and investigations in the ordinary course of business, including claims relating to employee relations, business practices and patent infringement. The Company is involved in litigation matters not listed herein. Although the results of these proceedings, claims, and investigations cannot be predicted with certainty, the Company does not believe that the final outcome of any matters that it is currently involved in are reasonably likely to have a material adverse effect on its business, financial condition, or results of operations.

Indemnification

In the ordinary course of business, the Company has entered into contractual arrangements which provide indemnification provisions of varying scope and terms to business partners and other parties with respect to certain matters, including, but not limited to, losses arising out of the Company's breach of such agreements and out of intellectual property infringement claims made by third parties. The Company's obligations under these agreements may be limited in terms of time or amount, and in some instances, the Company may have recourse against third parties for certain payments. In addition, the Company has entered into indemnification agreements with its directors and certain of its officers that will require it, among other things, to indemnify them against certain liabilities that may arise by reason of their status or service as directors or officers.

It is not possible to determine the maximum potential amount under these indemnification obligations due to the limited history of prior indemnification claims and the unique facts and circumstances involved in each agreement. To date, the Company has not incurred any material costs as a result of such obligations and have not accrued any liabilities related to such obligations in the consolidated financial statements.

13. INCOME TAXES

The components of loss before income taxes consist of the following (in thousands):

	Years Ended December 31,		
	2019	2018	2017
United States	\$ (63,453)	\$ (11,128)	\$ (63,831)
Foreign	2,534	1,795	637
Net loss before income taxes	<u>\$ (60,919)</u>	<u>\$ (9,333)</u>	<u>\$ (63,194)</u>

The income tax (benefit) expense consisted of the following (in thousands):

	Years Ended December 31,		
	2019	2018	2017
Current:			
Federal	\$ (47)	\$ —	\$ —
State	244	114	89
Foreign	108	184	674
	<u>305</u>	<u>298</u>	<u>763</u>
Deferred:			
Foreign	(1,287)	(774)	(448)
Total	<u>\$ (982)</u>	<u>\$ (476)</u>	<u>\$ 315</u>

The following is a reconciliation of the statutory federal income tax rate to the Company's effective tax rate:

	Years Ended December 31,		
	2019	2018	2017
U.S. federal income tax at statutory rate	21.0%	21.0%	34.0%
U.S. state and local income taxes	(0.4)	(1.3)	(0.2)
Change in valuation allowance	(213.4)	(1,039.4)	19.0
Federal research and development tax credit	30.8	166.2	5.2
Convertible preferred stock warrants	—	—	(21.7)
Stock-based compensation	158.0	859.4	1.2
Meals and Entertainment	(1.4)	(6.6)	(1.1)
Permanent items	—	(1.1)	—
Foreign rate differential	(0.6)	(1.5)	0.2
Acquisition costs	(1.3)	—	—
Section 162(m) limitation	(1.4)	—	—
State apportionment change	1.3	—	—
Tax rate change	(0.4)	2.4	(36.4)
Provision to return true-up	9.9	5.9	—
Other	(0.5)	0.1	(0.7)
Effective tax rate	1.6%	5.1%	(0.5)%

Significant components of the Company's deferred income tax assets and liabilities consist of the following (in thousands):

	As of December 31,	
	2019	2018
Deferred tax assets:		
Net operating loss carryforwards	\$ 263,512	\$ 128,829
Reserves and accruals	10,425	7,840
Research and development credits	73,442	39,344
Lease Obligation	81,639	—
Stock-based compensation	17,494	7,529
Total deferred tax assets	446,512	183,542
Deferred tax liabilities:		
Right-of-use asset	(72,243)	—
Depreciation and amortization	(10,916)	(343)
Total deferred tax liabilities	(83,159)	(343)
Valuation allowance	(361,233)	(182,360)
Net deferred tax assets	\$ 2,120	\$ 839

A valuation allowance is provided when it is more likely than not that some portion of the deferred tax assets will not be realized through future operations. As a result of the Company's analysis of all available objective evidence, both positive and negative, as of December 31, 2019, management believes it is more likely than not that the deferred tax assets will not be fully realizable. Accordingly, the Company has provided a full valuation allowance against its deferred tax assets with the exception of deferred tax assets related to foreign entities in the U.K. and Denmark.

The Company's valuation allowance increased by \$178.9 million and \$114.1 million during the years ended December 31, 2019 and 2018, respectively, primarily due to U.S. federal and state tax losses and credits incurred during the period.

For federal and state income tax reporting purposes, respective net operating loss carryforwards of \$1,005.4 million and \$851.7 million are available to reduce future taxable income, if any. These net operating loss

carryforwards will begin to expire in 2028 for federal and certain state net operating losses have expired in 2019. The federal net operating loss generated subsequent to 2017 can be carried forward indefinitely.

For U.K. and Denmark income tax reporting purposes, the net operating loss carryforward of \$9.4 million and \$0.1 million, respectively, is available to reduce the future taxable income, if any. U.K. and Denmark net operating loss can be carried forward indefinitely. The Company also has U.K. research and development tax credit carryforwards of \$0.2 million. The credit can be carried forward indefinitely.

As of December 31, 2019, the Company has research and development tax credit carryforwards of \$58.3 million and \$40.0 million for federal and state income tax purposes, respectively. If not utilized, the federal and state carryforwards will begin to expire in 2028 and 2035, respectively.

The Internal Revenue Code of 1986, as amended (the "Code"), contains provisions that may limit the net operating loss and credit carryforwards available for use in any given period upon the occurrence of certain events, including a statutorily defined significant change in ownership. Utilization of the net operating loss and tax credit carryforwards is subject to an annual limitation due to an ownership change, as defined by section 382 of the Code. The Company has assessed whether any section 382 ownership change has occurred since its formation and determined that a section 382 ownership change occurred on December 18, 2009 and tax attributes generated by the Company through the ownership change date are subject to the limitation.

A Section 382 study was completed for dataxu covering the period from inception beginning May 1, 2008 through acquisition date of November 8, 2019. Based on the study, the Company identified four ownership changes for Section 382 purposes. As such, tax attributes generated by dataxu through the ownership change dates are subject to the limitation.

The total amount of unrecognized tax benefits as of December 31, 2019 is \$19.5 million, of which \$18.3 million is composed of research and development credits and \$1.2 million is related international activities. A reconciliation of the beginning and ending amount of unrecognized tax benefits is as follows (in thousands):

	As of December 31,	
	2019	2018
Unrecognized tax benefits at beginning of year	\$ 14,541	\$ 5,843
Gross increase for tax positions of current year	10,378	7,053
Gross decrease due to statute expiration	(88)	—
Gross increase for tax positions of prior years	—	1,645
Gross decrease for tax positions of prior years	(5,344)	—
Unrecognized tax benefits balance at end of year	<u>\$ 19,487</u>	<u>\$ 14,541</u>

The Company recognizes interest and penalties related to unrecognized tax benefits as a component of its income tax expense. As of December 31, 2019, the Company recorded \$0.3 million of accrued interest and penalties related to uncertain tax positions.

Change in the Company's unrecognized tax benefits, if any, would have an immaterial impact on its effective tax rate. The Company does not believe unrecognized tax benefits will change significantly in the next 12 months.

The Company files income tax returns in the U.S. federal jurisdiction and various state jurisdictions. In the normal course of business, the Company is subject to examination by taxing authorities. These audits include questioning the timing and amount of deductions; the nexus of income among various tax jurisdictions; and compliance with federal, state, and local tax laws. The Company is not currently under audit by the Internal Revenue Service or other similar state and local authorities. All tax years remain open to examination by major taxing jurisdictions to which the Company is subject.

The Company will continue to reinvest earnings from our foreign subsidiaries indefinitely. While federal income tax expense has been recognized as a result of the Tax Cuts and Jobs Act of 2017, the Company has not provided any additional deferred taxes with respect to items such as foreign withholding taxes, state income tax or foreign exchange gain or loss. It is not practicable for the Company to determine the amount of unrecognized tax expense on these reinvested international earnings.

14. RELATED-PARTY TRANSACTIONS

The Company has engaged in transactions with one of its strategic investors. With respect to this investor, the Company recorded revenue of \$8.5 million, \$4.1 million and \$0.6 million for the years ended December 31, 2019, 2018 and 2017 respectively. The Company had an accounts receivable balance of \$2.4 million as of December 31, 2019 and 2018, related to transactions with this investor. The Company incurred expenses of \$1.3 million, \$1.3 million and \$0.2 million with this investor for the years ended December 31, 2019, 2018 and 2017, respectively. The Company had a payable of \$0.4 million and \$1.5 million to this investor as of December 31, 2019 and 2018, respectively.

In addition, the Company has engaged in transactions with another company in which the Company's Chief Executive Officer holds a majority voting interest and is a member of such company's board of directors, and another member of the Company's Board of Directors is such company's Chief Executive Officer. With respect to transactions with this other company, the Company incurred expenses of \$1.2 million for the year ended December 31, 2019. The Company did not consummate any transactions with the other company for the years ended December 31, 2018 and 2017. There were no outstanding amounts payable to this other company as of December 31, 2019, 2018 and 2017.

15. RETIREMENT PLANS

The Company maintains a 401(k) tax deferred saving plan (the "Savings Plan") for the benefit of qualified employees. Qualified employees may elect to make contributions to the Savings Plan on a biweekly basis, subject to certain limitations. The Company may make contributions to the Savings Plan at the discretion of the Board of Directors. No contributions were made for the years ended December 31, 2019, 2018 and 2017.

In 2014, the Company established a defined contribution plan in the U.K. for its U.K.-based employees. The Company contributed \$0.5 million, \$0.4 million and \$0.3 million to the plan for the years ended December 31, 2019, 2018 and 2017, respectively.

16. NET LOSS PER SHARE

The Company's basic net loss per share is calculated by dividing the net loss by the weighted-average number of shares of common stock outstanding for the period. For purposes of the calculation of diluted net loss per share options to purchase common stock, restricted stock units, unvested shares of common stock issued upon the early exercise of stock options and business acquisitions and warrants to purchase common stock are considered common stock equivalents but have been excluded from the calculation of diluted net loss per share as their effect is antidilutive. Because the Company has reported a net loss for the years ended December 31, 2019, 2018 and 2017, diluted net loss per common share is the same as the basic net loss per share for those years.

The table presents the calculation of basic and diluted net loss per share as follows (in thousands, except per share data):

	Years Ended December 31,		
	2019	2018	2017
Numerator:			
Net loss allocable to common stockholders	\$ (59,937)	\$ (8,857)	\$ (63,509)
Denominator:			
Weighted-average shares used in computing net loss per share, basic and diluted	115,218	104,618	28,308
Net loss per share, basic and diluted	\$ (0.52)	\$ (0.08)	\$ (2.24)

The potential common shares that were excluded from the calculation of diluted net loss per share because their effect would have been antidilutive for the periods presented are as follows (in thousands):

	Years Ended December 31,		
	2019	2018	2017
Equity awards to purchase common stock	15,668	20,057	26,608
Unvested shares of common stock issued upon early exercise of stock options and business acquisition	31	70	57
Warrants to purchase common stock	—	—	184
Total	15,699	20,127	26,849

17. SEGMENT INFORMATION

An operating segment is defined as a component of an entity for which discrete financial information is available that is evaluated regularly by the chief operating decision maker ("CODM") for purposes of allocating resources and evaluating financial performance. The Company uses the management approach to determine the segment financial information that should be disaggregated and presented separately in the Company's notes to its consolidated financial statements. The management approach is based on the manner by which management has organized the segments within the Company for making operating decisions, allocating resources, and assessing performance.

The Company reports its financial results consistent with the manner in which financial information is viewed by management for decision-making purposes. The Company does not manage operating expenses such as research and development, sales and marketing and general and administrative expenses at the segment level.

The Company's CODM is its Chief Executive Officer, and the CODM evaluates performance and makes decisions about allocating resources to its operating segments based on financial information presented on a consolidated basis and on revenue and gross profit for each operating segment. In the second quarter of 2017 the Company changed the operating segments to combine one of the previous operating segments with two existing segments to reflect how the CODM evaluates performance and allocates resources. This change did not result in a change to the reportable segments.

The Company is organized into two reportable segments as follows:

Platform

Consists primarily of fees received from advertisers and content publishers, and from licensing the Company's technology and proprietary operating system to service operators. Platform revenue primarily includes fees earned from the sale of digital advertising and revenue share from new or recurring user subscriptions activated through the Company's platform and revenue share from user purchases of content publishers' media through its platform. The Company also earns revenue from the sale of branded channel buttons on player and TV remote controls.

Player

Consists primarily of net sales of streaming media players, audio products and accessories through retailers and distributors, as well as directly to customers through the Company's website.

The Company does not allocate property and equipment or any other assets or capital expenditures to reportable segments. Operating expenses are not managed at the segment level.

The Company evaluates the performance of its reportable segments based on the financial measures, including segment gross profit, which are regularly reviewed by the CODM and provide insight into the individual segments and their ability to contribute to Company's operating results.

Customers accounting for 10% or more of segment revenue, net, were as follows:

	Years Ended December 31.		
	2019	2018	2017
Platform segment revenue			
Customer E	*	*	13%
Player segment revenue			
Customer A	16%	15%	15%
Customer B	17%	15%	12%
Customer C	39%	38%	34%

Revenue in international markets was less than 10% in each of the periods presented. Substantially all Company assets were held in the United States and were attributable to the operations in the United States as of December 31, 2019 and 2018.

18. QUARTERLY FINANCIAL DATA (Unaudited)

The following table summarizes the Company's information on total revenue, gross profit, net income (loss) and earnings per share by quarter for the years ended December 31, 2019 and 2018. This data was derived from the Company's unaudited consolidated financial statements (in thousands, except per share data):

	Three Months Ended			
	Dec 31, 2019	Sep 30, 2019	Jun 30, 2019	Mar 31, 2019
Total Revenue	\$ 411,230	\$ 260,928	\$ 250,101	\$ 206,662
Gross Profit	161,647	118,477	114,209	100,891
Net loss attributable to common stockholders	(15,717)	(25,155)	(9,333)	(9,732)
Basic and diluted net loss per share attributable to common stockholders	(0.13)	(0.22)	(0.08)	(0.09)

	Three Months Ended			
	Dec 31, 2018	Sep 30, 2018	Jun 30, 2018	Mar 31, 2018
Total Revenue	\$ 275,739	\$ 173,381	\$ 156,810	\$ 136,576
Gross Profit	112,291	78,993	77,752	63,112
Net income (loss) attributable to common stockholders	6,778	(9,527)	526	(6,634)
Basic net income (loss) per share attributable to common stockholders	0.06	(0.09)	0.01	(0.07)
Diluted net income (loss) per share attributable to common stockholders	0.05	(0.09)	0.00	(0.07)

Item 9. Changes in and Disagreements with Accountants on Accounting and Financial Disclosure

None.

Item 9A. Controls and Procedures***Evaluation of Disclosure Controls and Procedures***

Our management, with the participation of our Chief Executive Officer and our Chief Financial Officer, has evaluated the effectiveness of our disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Securities and Exchange Act of 1934, as amended, or the Exchange Act) prior to the filing of this Annual Report on Form 10-K. Based on such evaluation, our Chief Executive Officer and Chief Financial Officer have concluded that, as of the end of the period covered by this Annual Report on Form 10-K, our disclosure controls and procedures were, in design and operation, effective at the reasonable assurance level.

Changes in Internal Control over Financial Reporting

There was no change in our internal control over financial reporting identified in connection with the evaluation required by Rule 13a-15(d) and 15d-15(d) of the Exchange Act that occurred during the quarter ended December 31, 2019 that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

Management's Report on Internal Control over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting (as defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act). Our internal control over financial reporting is designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles.

Under the supervision and with the participation of our management, including our Chief Executive Officer and Chief Financial Officer, we conducted an evaluation of the effectiveness of our internal control over financial reporting based on the framework set forth in Internal Control — Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission. Our assessment excluded internal controls over financial reporting of dataxu, Inc. which was acquired on November 8, 2019 and whose total assets represent approximately 6.1% and total revenues represent approximately 1.5% of our consolidated financial statement amounts as of and for the year ended December 31, 2019. Based on our evaluation under the framework set forth in *Internal Control — Integrated Framework (2013)*, our management concluded that our internal control over financial reporting was effective as of December 31, 2019.

The effectiveness of our internal control over financial reporting as of December 31, 2019 has been audited by Deloitte & Touche LLP, an independent registered public accounting firm, as stated in its report which is included below.

Inherent Limitations on Effectiveness of Controls

Our management, including our Chief Executive Officer and Chief Financial Officer, does not expect that our disclosure controls and procedures or our internal controls will prevent all errors and all fraud. A control system, no matter how well conceived and operated, can provide only reasonable, not absolute, assurance that the objectives of the control system are met. Further, the design of a control system must reflect the fact that there are resource constraints, and the benefits of controls must be considered relative to their costs. Our disclosure controls and procedures and our internal controls over financial reporting have been designed to provide reasonable assurance of achieving their objectives. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud, if any, have been detected.

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Stockholders and the Board of Directors of Roku, Inc.

Opinion on Internal Control over Financial Reporting

We have audited the internal control over financial reporting of Roku, Inc. and subsidiaries (the “Company”) as of December 31, 2019, based on criteria established in *Internal Control — Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). In our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2019, based on criteria established in *Internal Control — Integrated Framework (2013)* issued by COSO.

We have also audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the consolidated financial statements as of and for the year ended December 31, 2019, of the Company and our report dated February 28, 2020, expressed an unqualified opinion on those financial statements and included an explanatory paragraph related to the Company’s change in method of accounting for leases in fiscal year 2019 due to the adoption of Accounting Standards Update No. 2016-02, *Leases (Topic 842)*, and the Company’s change in method of accounting for revenue in fiscal year 2018 due to the adoption of Accounting Standards Update No. 2014-09, *Revenue from Contracts with Customers (Topic 606)*.

As described in Management’s Report on Internal Control Over Financial Reporting, management excluded from its assessment the internal control over financial reporting at dataxu, Inc., which was acquired on November 8, 2019, whose total assets represent approximately 6.1% and total revenues represent approximately 1.5% of the consolidated financial statement amounts of the Company as of and for the year ended December 31, 2019. Accordingly, our audit did not include the internal control over financial reporting at dataxu, Inc.

Basis for Opinion

The Company’s management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting, included in the accompanying Management’s Report on Internal Control over Financial Reporting. Our responsibility is to express an opinion on the Company’s internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects. Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

Definition and Limitations of Internal Control over Financial Reporting

A company’s internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company’s internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company’s assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ DELOITTE & TOUCHE LLP

San Jose, California

February 28, 2020

Item 9B. Other Information

Based on the elections made by our named executive officers, our Compensation Committee of our Board of Directors has established the annual salaries and monthly stock option allocations for 2020 under the terms of our Executive Supplemental Stock Option Program for our named executive officers as follows:

Name	Annual Salary	Annual Stock Option Allocation Amount	Monthly Stock Option Allocation Amount
Anthony Wood <i>President and Chief Executive Officer</i>	\$ 800,000	\$ 400,000	\$ 33,333

The number of options granted is determined by the following formula: (i) the monthly dollar amount by which the officer has elected to reduce their annual base salary, divided by (ii) the quotient of (x) the closing price of our Class A common stock as reported by The Nasdaq Global Select Market on the date of grant and (y) 2.9. Each monthly grant is made on the first trading day of the month (contingent upon the officer's continued service as of that date), is fully vested on the grant date and will have an exercise price equal to the closing price of our Class A common stock as reported by The Nasdaq Global Select Market on the date of grant. The options are subject to the terms and conditions of the Company's 2017 Plan and will be administered on a non-discretionary basis without further action by our Compensation Committee. These stock options are exercisable for up to ten years following the date of grant regardless of the employment status of the officer.

PART III

Item 10. Directors, Executive Officers and Corporate Governance

The information required by this item is incorporated by reference to our definitive Proxy Statement for the 2020 Annual Meeting of Stockholders to be filed with the SEC within 120 days after the end of our year ended December 31, 2019.

Item 11. Executive Compensation

The information required by this item is incorporated by reference to our definitive Proxy Statement for the 2020 Annual Meeting of Stockholders to be filed with the SEC within 120 days after the end of our year ended December 31, 2019.

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters

The information required by this item is incorporated by reference to our definitive Proxy Statement for the 2020 Annual Meeting of Stockholders to be filed with the SEC within 120 days after the end of our year ended December 31, 2019.

Item 13. Certain Relationships and Related Transactions, and Director Independence

The information required by this item is incorporated by reference to our definitive Proxy Statement for the 2020 Annual Meeting of Stockholders to be filed with the SEC within 120 days after the end of our year ended December 31, 2019.

Item 14. Principal Accounting Fees and Services

The information required by this item is incorporated by reference to our definitive Proxy Statement for the 2020 Annual Meeting of Stockholders to be filed with the SEC within 120 days after the end of our year ended December 31, 2019.

PART IV

Item 15. Exhibits, Financial Statement Schedules

(a)(1) Financial Statements

See Index to Financial Statements in Item 8 of this Report.

(a)(2) Financial Statement Schedule

All financial statement schedules have been omitted as the information is not required under the related instructions or is not applicable or because the information required is already included in the financial statements or the notes to those financial statements.

(a)(3) Exhibits

The documents set forth below are filed herewith or incorporated herein by reference to the location indicated.

Number	Exhibit Title	Incorporated by Reference			Filing Date	Filed Herewith
		Form	File No.	Exhibit		
2.1	Agreement and Plan of Merger, dated October 22, 2019, by and among Roku, Inc., Delaware Acquisition Company, Inc., dataxu, Inc. and Shareholder Representative Services LLC, as Stockholder Representative and Amendment No. 1 to Agreement and Plan of Merger, dated November 8, 2019, by and among Roku, Inc., Delaware Acquisition Company, Inc., dataxu, Inc. and Shareholder Representative Services LLC, as Stockholder Representative.	8-K	001-38211	2.1	11/14/2019	
3.1	Amended and Restated Certificate of Incorporation.	8-K	001-38211	3.1	10/3/2017	
3.2	Amended and Restated Bylaws.	S-1/A	333-220318	3.4	9/18/2017	
4.1	Reference is made to Exhibit 3.1.					
4.2	Form of Class A Common Stock Certificate.	S-1/A	333-220318	4.1	9/18/2017	
4.3	Description of Securities.					X
4.4	Amended and Restated Investor Rights Agreement, by and among Roku, Inc. and the investors listed on Exhibit A thereto, dated November 9, 2015.	S-1	333-220318	10.1	9/1/2017	
4.5	Amendment to the Amended and Restated Investor Rights Agreement, dated March 6, 2017.	S-1	333-220318	10.2	9/1/2017	
10.1 +	Roku, Inc. 2008 Equity Incentive Plan.	S-1	333-220318	10.3	9/1/2017	
10.2 +	Forms of Option Agreement and Option Grant Notice under 2008 Equity Incentive Plan.	S-1	333-220318	10.4	9/1/2017	
10.3 +	Roku, Inc. 2017 Equity Incentive Plan.	S-1/A	333-220318	10.5	9/18/2017	
10.4 +	Forms of Option Agreement and Option Grant Notice under 2017 Equity Incentive Plan.	S-1/A	333-220318	10.6	9/18/2017	
10.5 +	Forms of Restricted Stock Unit Grant Notice and Award Agreement under 2017 Equity Incentive Plan.	S-1/A	333-220318	10.7	9/18/2017	
10.6 +	Forms of Option Agreement and Option Grant Notice under 2017 Equity Incentive Plan.	10-Q	001-38211	10.24	8/10/2018	

10.7 +	<u>Forms of Restricted Stock Unit Grant Notice and Award Agreement under 2017 Equity Incentive Plan (Employees).</u>						X
10.8 +	<u>Forms of Restricted Stock Unit Grant Notice and Award Agreement under 2017 Equity Incentive Plan (Non-Employee Directors).</u>	10-Q	001-38211	10.7	8/9/2019		
10.9 +	<u>Forms of Option Grant Notice and Option Agreement under 2017 Equity Incentive Plan (Non-Employee Directors).</u>	10-Q	001-38211	10.8	8/9/2019		
10.10 +	<u>Executive Supplemental Stock Option Program Enrollment Form.</u>	8-K	001-38211	10.1	12/7/2018		
10.11 +	<u>Forms of Option Grant Notice and Executive Supplemental Stock Option Agreement and Option Grant Notice under 2017 Equity Incentive Plan.</u>	8-K	001-38211	10.2	12/7/2018		
10.12 +	<u>Roku, Inc. 2017 Employee Stock Purchase Plan.</u>	S-1/A	333-220318	10.8	9/18/2017		
10.13 +	<u>Form of Indemnification Agreement, by and between Roku, Inc. and each of its directors and executive officers.</u>	S-1A	333-220318	10.9	9/18/2017		
10.14 +	<u>Employment Terms Agreement, by and between Roku, Inc. and Stephen Kay, dated November 15, 2013.</u>	S-1	333-220318	10.9	9/1/2017		
10.15 +	<u>Employment Terms Agreement, by and between Roku, Inc. and Steve Loudon, dated June 11, 2015.</u>	S-1	333-220318	10.11	9/1/2017		
10.16 +	<u>Employment Terms Agreement, by and between Roku, Inc. and Charles Smith, dated August 27, 2012.</u>	S-1	333-220318	10.12	9/1/2017		
10.17 +	<u>Employment Terms Agreement, by and between Roku, Inc. and Scott Rosenberg, dated October 30, 2012.</u>	S-1	333-220318	10.13	9/1/2017		
10.18 +	<u>Employment Terms Agreement, by and between Roku, Inc. and Mustafa Ozgen, dated January 17, 2019.</u>						X
10.19 +	<u>Independent Contractor Services Agreement by and between Roku, Inc. and Neil Hunt, dated September 10, 2017.</u>	S-1/A	333-220318	10.30	9/18/2017		
10.20 +	<u>Roku, Inc. Amended and Restated Severance Benefit Plan.</u>	8-K	001-38211	99.1	7/16/2019		
10.21	<u>Sublease for 170/180 Knowles Drive, by and between Roku, Inc. and Netflix, Inc., dated August 18, 2015.</u>	S-1	333-220318	10.26	9/1/2017		
10.22	<u>Sublease for 100 Winchester Circle, by and between Roku, Inc. and Netflix, Inc., dated August 18, 2015.</u>	S-1	333-220318	10.27	9/1/2017		
10.23	<u>Sublease for 150 Winchester Circle, by and between Roku, Inc. and Netflix, Inc., dated August 18, 2015.</u>	S-1	333-220318	10.28	9/1/2017		
10.24	<u>Coleman Highline Office Lease by and between Roku, Inc. and Cap Phase 1, LLC dated August 1, 2018 (1155 Coleman Ave).</u>	10-Q	001-38211	10.26	8/10/2018		
10.25	<u>Coleman Highline Office Lease by and between Roku, Inc. and Cap Oz 34, LLC dated August 1, 2018 (1173/1167/1161 Coleman Ave).</u>	10-Q	001-38211	10.27	8/10/2018		
10.26	<u>First Amendment to Coleman Highline Office Lease by and between Roku, Inc. and Cap Phase 1, LLC dated November 12, 2018 (1155 Coleman Ave).</u>	10-K	001-38211	10.30	3/1/2019		
10.27	<u>First Amendment to Coleman Highline Office Lease by and between Roku, Inc. and Cap Oz 34, LLC dated November 18, 2018 (1173/1167/1161 Coleman Ave).</u>	10-K	001-38211	10.31	3/1/2019		
10.28	<u>Credit Agreement, dated as of February 19, 2019, by and among Roku, Inc., Morgan Stanley Senior Funding, Inc., as lender, issuing bank, administrative agent and collateral agent, and the other issuing banks and lenders party thereto from time to time.</u>	10-K	001-38211	10.32	3/1/2019		

10.29	<u>Assignment and Assumption of Lease, Landlord's Consent and First Amendment of Lease, dated as of April 30, 2019, by and among Roku, Inc., 8x8, Inc. and CAP Phase I, LLC.</u>	10-Q	001-38211	10.1	8/9/2019	
10.30	<u>Second Amendment to Coleman Highline Office Lease by and between Roku, Inc. and Cap Phase I, LLC dated April 30, 2019 (1155 Coleman Ave).</u>	10-Q	001-38211	10.2	8/9/2019	
10.31	<u>Second Amendment to Coleman Highline Office Lease by and between Roku, Inc. and Cap Oz 34, LLC dated April 30, 2019 (1173/1167/1161 Coleman Ave).</u>	10-Q	001-38211	10.3	8/9/2019	
10.32	<u>Incremental Assumption and Amendment No. 1 to Credit Agreement, dated as of May 3, 2019, by and among Roku, Inc., Morgan Stanley Senior Funding, Inc., as administrative agent and issuing bank, and the other issuing banks and lenders party thereto from time to time.</u>	10-Q	001-38211	10.4	8/9/2019	
21.1	<u>List of Subsidiaries of Roku, Inc.</u>					X
23.1	<u>Consent of Independent Registered Public Accounting Firm.</u>					X
24.1	<u>Power of Attorney.</u>					X
31.1	<u>Certification of Chief Executive Officer pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.</u>					X
31.2	<u>Certification of Chief Financial Officer pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.</u>					X
32.1	<u>Certification of Chief Executive Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002. *</u>					X
32.2	<u>Certification of Chief Financial Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002. *</u>					X
101.INS	Inline XBRL Instance Document.					X
101.SCH	Inline XBRL Taxonomy Extension Schema Document.					X
101.CAL	Inline XBRL Taxonomy Extension Calculation Linkbase Document.					X
101.DEF	Inline XBRL Taxonomy Extension Definition.					X
101.LAB	Inline XBRL Taxonomy Extension Label Linkbase					X
101.PRE	Inline XBRL Taxonomy Extension Presentation Linkbase Document.					X
104	Cover Page Interactive Data File (formatted as inline XBRL with applicable taxonomy extension information contained in Exhibits 101).					

* These exhibits are furnished with this Annual Report on Form 10-K and are not deemed filed with the Securities and Exchange Commission and are not incorporated by reference in any filing of Roku, Inc. under the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended, whether made before or after the date hereof and irrespective of any general incorporation language contained in such filings.

+ Indicates a management contract or compensatory plan or arrangement.

Item 16. Form 10-K Summary

None.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this Annual Report on Form 10-K to be signed on its behalf by the undersigned, thereunto duly authorized, on this 28th day of February 2020.

Roku, Inc.

By: /s/ Anthony Wood

Anthony Wood
President and Chief Executive Officer
(Principal Executive Officer)

By: /s/ Steve Louden

Steve Louden
Chief Financial Officer
(Principal Financial Officer)

**DESCRIPTION OF THE REGISTRANT'S SECURITIES
REGISTERED PURSUANT TO SECTION 12 OF THE
SECURITIES EXCHANGE ACT OF 1934**

Roku, Inc. ("Roku," "we," "our," or "us") has one class of securities registered under Section 12 of the Securities Exchange Act of 1934, as amended — our Class A common stock, \$0.0001 par value per share. The following description of our capital stock is a summary and does not purport to be complete. It is subject to, qualified in its entirety by, and should be read in conjunction with, Delaware law and our certificate of incorporation and bylaws, each of which is filed as an exhibit to our Annual Report on Form 10-K, of which this exhibit 4.3 is a part, and are incorporated by reference herein. We encourage you to read our certificate of incorporation, our bylaws, and the applicable provisions of the Delaware General Corporation Law for more information.

Authorized Capital Stock

Our authorized capital stock consists of 1,160,000,000 shares, all with a par value of \$0.0001 per share, of which:

- 1,000,000,000 shares are designated as Class A common stock;
- 150,000,000 shares are designated as Class B common stock; and
- 10,000,000 shares are designated as preferred stock.

Class A and Class B Common Stock

Except with respect to voting, conversion and transfer rights as described below and as otherwise expressly provided in our amended and restated certificate of incorporation or required by applicable law, shares of Class A common stock and Class B common stock have the same rights and privileges and rank equally, share ratably and are identical in all respects as to all matters.

Dividend and Distribution Rights

Subject to the prior rights of holders of all classes and series of stock at the time outstanding having prior rights as to dividends, the holders of Class A common stock and Class B common stock will be entitled to receive, when, as and if declared by the board of directors, out of any assets of Roku legally available therefor, such dividends as may be declared from time to time by the board of directors. Any dividends paid to the holders of Class A common stock and Class B common stock shall be paid pro rata, on an equal priority, pari passu basis, unless different treatment of the shares of each such class is approved by the affirmative vote of the holders of the majority of the outstanding shares of the applicable class of common stock treated adversely, voting separately as a class. We will not declare or pay any dividend or make any other distribution to the holders of Class A common stock or Class B common stock payable in securities of Roku unless the same dividend or distribution with the same record date and payment date shall be declared and paid on all shares of common stock; provided, however, that (i) dividends or other distributions payable in shares of Class A common stock or rights to acquire shares of Class A common stock may be declared and paid to the holders of Class A common stock without the same dividend or distribution being declared and paid to the holders of the Class B common stock if, and only if, a dividend payable in shares of Class B common stock, or rights to acquire shares of Class B common stock, as applicable, are declared and paid to the holders of Class B common stock at the same rate and with the same record date and payment date; and (ii) dividends or other distributions payable in shares of Class B common stock or rights to acquire shares of Class B common stock may be declared and paid to the holders of Class B common stock without the same dividend or distribution being declared and paid to the holders of the Class A common stock if, and only if, a dividend payable in shares of Class A common stock, or rights to acquire shares of Class A common stock, as applicable, are declared and paid to the holders of Class A common stock at the same rate and with the same record date and payment date.

Voting Rights

Holders of our Class A common stock and Class B common stock have identical rights, provided that, except as otherwise expressly provided in our amended and restated certificate of incorporation or required by applicable law, on any matter that is submitted to a vote of our stockholders, holders of our Class A common stock are entitled

to one vote per share of Class A common stock and holders of our Class B common stock are entitled to 10 votes per share of Class B common stock. Holders of shares of Class A common stock and Class B common stock will vote together as a single class on all matters (including the election of directors) submitted to a vote of stockholders, except that there will be a separate vote of our Class A common stock in order for us to, directly or indirectly, effect an asset transfer, acquisition or liquidation event (each as defined in our amended and restated certificate of incorporation) pursuant to which the Class A common stock would not receive equivalent consideration (as defined in our amended and restated certificate of incorporation) to the Class B common stock, and there will be a separate vote of our Class B common stock in order for us to, directly or indirectly, take action in the following circumstances:

- if we propose to amend, alter or repeal any provision of our amended and restated certificate of incorporation or our amended and restated bylaws that modifies the voting, conversion or other powers, preferences or other special rights or privileges or restrictions of the Class B common stock;
- if we reclassify any outstanding shares of Class A common stock into shares having rights as to dividends or liquidation that are senior to the Class B common stock or the right to more than one vote for each share thereof; or
- if we effect an asset transfer, acquisition or liquidation event (each as defined in our amended and restated certificate of incorporation) pursuant to which the Class B common stock would not receive equivalent consideration (as defined in our amended and restated certificate of incorporation) to the Class A common stock.

We may not increase or decrease the authorized number of shares of Class A common stock or Class B common stock without the affirmative vote of the holders of a majority of the combined voting power of the outstanding shares of Class A common stock and Class B common stock, voting together as a single class.

We have not provided for cumulative voting for the election of directors in our amended and restated certificate of incorporation.

No Preemptive or Similar Rights

Our Class A common stock and Class B common stock are not entitled to preemptive rights and are not subject to conversion, redemption or sinking fund provisions. The rights, preferences and privileges of the holders of our common stock are subject to, and may be adversely affected by, the rights of the holders of any series of our preferred stock that we may designate and issue in the future.

Liquidation Rights

In the event of our liquidation, dissolution or winding-up, upon the completion of the distributions required with respect to any series of preferred stock that may then be outstanding, our remaining assets legally available for distribution to stockholders shall be distributed on an equal priority, pro rata basis to the holders of Class A common stock and Class B common stock.

Subdivisions and Combinations

If we subdivide or combine in any manner outstanding shares of Class A common stock or Class B common stock, then the outstanding shares of all common stock will be subdivided or combined in the same proportion and manner.

Conversion

Each share of Class B common stock is convertible at any time at the option of the holder into one share of Class A common stock. In addition, each share of Class B common stock will convert into one share of Class A common stock upon any transfer, whether or not for value and whether voluntary or involuntary or by operation of law, except for certain transfers described in our amended and restated certificate of incorporation, including, without

limitation, certain transfers for tax and estate planning purposes. All shares of Class B common stock will convert into Class A common stock on the earlier of (a) the first trading day on or after the date on which the outstanding shares of Class B common stock represent less than 10% of the then outstanding Class A common stock and Class B common stock or (b) the date specified by vote of the holders of 66 2/3% of the outstanding shares of Class B common stock, voting as a single class.

Stockholder Registration Rights

We are party to an investor rights agreement which provides that certain holders of our common stock and common stock issuable upon the exercise of outstanding warrants, including certain holders of 5% of our capital stock and entities affiliated with certain of our directors, have certain registration rights, as set forth below. These shares are referred to as registrable securities. This investor rights agreement was entered into in February 2008 and has been amended and restated from time to time in connection with our preferred stock financings. The registration of shares of our Class A common stock pursuant to the exercise of registration rights described below would enable the holders to sell these shares without restriction under the Securities Act when the applicable registration statement is declared effective. We will pay the registration expenses, other than underwriting discounts and selling commissions, of the shares registered pursuant to the demand, piggyback and Form S-3 registrations described below.

Generally, in an underwritten offering, the managing underwriter, if any, has the right, subject to specified conditions, to limit the number of shares such holders may include. The demand, piggyback and Form S-3 registration rights described below will expire three years after the effective date of the registration statement or with respect to any particular stockholder, such time as that stockholder holds less than 1% of the number of shares of our Class A common stock then outstanding and that stockholder can sell all of its shares under Rule 144 of the Securities Act during any three-month period.

Demand Registration Rights

The holders of the registrable securities are entitled to certain demand registration rights. The holders of a majority of the registrable securities may, on not more than two occasions, request that we register all or a portion of their shares. Such request for registration must cover 20% of such shares then outstanding.

Piggyback Registration Rights

If we propose to register for offer and sale any of our securities under the Securities Act in a public offering, either for our own account or for the account of other security holders, the holders of these shares will be entitled to certain "piggyback" registration rights allowing them to include their shares in such registration, subject to certain marketing and other limitations. As a result, whenever we propose to file a registration statement under the Securities Act, other than with respect to a demand registration or a registration statement on Forms S-4 or S-8 or related to stock issued upon conversion of debt securities, the holders of these shares are entitled to notice of the registration and have the right, subject to limitations that the underwriters may impose on the number of shares included in the registration, to include their shares in the registration.

Form S-3 Registration Rights

The holders of the registrable securities are entitled to certain Form S-3 registration rights. The holders of these shares can make a request that we register their shares on Form S-3 if we are qualified to file a registration statement on Form S-3 and if the reasonably anticipated aggregate gross proceeds of the shares offered would equal or exceed \$500,000. We will not be required to effect more than two registrations on Form S-3 in any twelve month period.

Anti-Takeover Provisions

Amended and Restated Certificate of Incorporation and Amended and Restated Bylaws

Among other things, our amended and restated certificate of incorporation and amended and restated bylaws:

- permit our board of directors to issue up to 10,000,000 shares of preferred stock, with a rights, preferences and privileges as they may designate, including the right to approve an acquisition or other change of control;
- provide that the authorized number of directors may be changed only by resolution of our board of directors;
- provide that our board of directors will be classified into three classes of directors;
- provide that, subject to the rights of any series of preferred stock to elect directors, directors may only be removed for cause, which removal may be effected, subject to any limitation imposed by law, by the holders of at least a majority of the voting power of all of our then-outstanding shares of the capital stock entitled to vote generally at an election of directors;
- provide that all vacancies, including newly created directorships, may, except as otherwise required by law, be filled by the affirmative vote of a majority of directors then in office, even if less than a quorum;
- require that any action to be taken by our stockholders must be effected at a duly called annual or special meeting of stockholders and not be taken by written consent or electronic transmission;
- provide that stockholders seeking to present proposals before a meeting of stockholders or to nominate candidates for election as directors at a meeting of stockholders must provide advance notice in writing, and also specify requirements as to the form and content of a stockholder's notice;
- provide that special meetings of our stockholders may be called only by the chairman of our board of directors, our chief executive officer or by our board of directors pursuant to a resolution adopted by a majority of the total number of authorized directors; and
- not provide for cumulative voting rights, therefore allowing the holders of a majority of the shares of common stock entitled to vote in any election of directors to elect all of the directors standing for election, if they should so choose.

The amendment of any of these provisions would require approval by the holders of at least 66 2/3% of the voting power of all of our then-outstanding capital stock entitled to vote generally in the election of directors, voting together as a single class.

The combination of these provisions will make it more difficult for our existing stockholders to replace our board of directors as well as for another party to obtain control of us by replacing our board of directors. Since our board of directors has the power to retain and discharge our officers, these provisions could also make it more difficult for existing stockholders or another party to effect a change in management. In addition, the authorization of undesignated preferred stock makes it possible for our board of directors to issue preferred stock with voting or other rights or preferences that could impede the success of any attempt to change our control.

These provisions are intended to enhance the likelihood of continued stability in the composition of our board of directors and its policies and to discourage coercive takeover practices and inadequate takeover bids. These provisions are also designed to reduce our vulnerability to hostile takeovers and to discourage certain tactics that may be used in proxy fights. However, such provisions could have the effect of discouraging others from making tender offers for our shares and may have the effect of delaying changes in our control or management. As a consequence, these provisions may also inhibit fluctuations in the market price of our stock.

Section 203 of the Delaware General Corporation Law

We are subject to Section 203 of the Delaware General Corporation Law, which prohibits a Delaware corporation from engaging in any business combination with any interested stockholder for a period of three years after the date that such stockholder became an interested stockholder, with the following exceptions:

- before such date, the board of directors of the corporation approved either the business combination or the transaction that resulted in the stockholder becoming an interested stockholder;

- upon closing of the transaction resulted in the stockholder becoming an interested stockholder, the interested stockholder owned at least 85% of the voting stock of the corporation outstanding at the time the transaction began, excluding for purposes of determining the voting stock outstanding (but not the outstanding voting stock owned by the interested stockholder) those shares owned by (1) persons who are directors and also officers and (2) employee stock plans in which employee participants do not have the right to determine confidentially whether shares held subject to the plan will be tendered in a tender or exchange offer; or
- on or after such date, the business combination is approved by the board of directors and authorized at an annual or special meeting of the stockholders, and not by written consent, by the affirmative vote of at least 66 2/3% of the outstanding voting stock that is not owned by the interested stockholder.

In general, Section 203 defines business combination to include the following:

- any merger or consolidation involving the corporation and the interested stockholder;
- any sale, transfer, pledge or other disposition of 10% or more of the assets of the corporation involving the interested stockholder;
- subject to certain exceptions, any transaction that results in the issuance or transfer by the corporation of any stock of the corporation to the interested stockholder;
- any transaction involving the corporation that has the effect of increasing the proportionate share of the stock or any class or series of the corporation beneficially owned by the interested stockholder; or
- the receipt by the interested stockholder of the benefit of any loss, advances, guarantees, pledges or other financial benefits by or through the corporation.

In general, Section 203 defines an “interested stockholder” as an entity or person who, together with the person’s affiliates and associates, beneficially owns, or within three years prior to the time of determination of interested stockholder status did own, 15% or more of the outstanding voting stock of the corporation.

Choice of Forum

Our amended and restated certificate of incorporation provides that the Court of Chancery of the State of Delaware is the exclusive forum for any derivative action or proceeding brought on our behalf; any action asserting a breach of fiduciary duty; any action asserting a claim against us arising pursuant to the Delaware General Corporation Law, our amended and restated certificate of incorporation or our bylaws; or any action asserting a claim against us that is governed by the internal affairs doctrine. Our amended and restated certificate of incorporation further provides that the federal district courts of the United States of America will be the exclusive forum for resolving any complaint asserting a cause of action arising under the Securities Act. In December 2018, the Delaware Chancery Court issued an opinion invalidating such provision which we have appealed to the Supreme Court of the State of Delaware.

Listing on The Nasdaq Global Select Market

Our Class A common stock is listed on the Nasdaq Global Select Market under the symbol “ROKU.”

Transfer Agent and Registrar

The transfer agent and registrar for our Class A and Class B common stock is American Stock Transfer & Trust Company, LLC. The transfer agent’s address is 6201 15th Avenue, Brooklyn, New York 11219, and its telephone number is (800) 937-5449.

ROKU, INC.
RESTRICTED STOCK UNIT GRANT NOTICE
(2017 EQUITY INCENTIVE PLAN)

Roku, Inc. (the "**Company**"), pursuant to its 2017 Equity Incentive Plan (the "**Plan**"), hereby awards to Participant a Restricted Stock Unit Award for the number of shares of the Company's Common Stock ("**Restricted Stock Units**") set forth below (the "**Award**"). The Award is subject to all of the terms and conditions as set forth in this notice of grant (this "**Restricted Stock Unit Grant Notice**"), the Restricted Stock Unit Award Agreement, including any special terms and conditions for Participant's country set forth in the appendix attached to the Award Agreement as Exhibit A (the "**Appendix**" and, together with the Restricted Stock Unit Award Agreement, the "**Award Agreement**"), and in the Plan, all of which are attached hereto and incorporated herein in their entirety. Capitalized terms not otherwise defined herein will have the meanings set forth in the Plan or the Award Agreement. In the event of any conflict between the terms in the Award Agreement and the Plan, the terms of the Plan will control.

Participant:				
Date		of		Grant:
Number	of	Restricted	Stock	Units/Shares:

Vesting Schedule: The first scheduled vest of the shares subject to the Award will vest on _____ and the remaining shares will vest in equal quarterly installments thereafter for so long as Participant remains in Continuous Service, such that at the end of such quarterly installments, the Award will be fully vested. The quarterly installments will vest on the dates of March 1, June 1, September 1, and November 15 (or the next business day if such date falls on a holiday or weekend). Please note the full vest schedule below:

Vesting tranches:
Number of shares subject to vest: Date subject to vest:

Total shares:

Issuance Schedule: The shares of Common Stock to be issued in respect of the Award will be issued in accordance with the issuance schedule set forth in Section 6 of the Restricted Stock Unit Award Agreement.

Additional Terms/Acknowledgements: Participant acknowledges receipt of, and understands and agrees to all of the terms and conditions set forth in this Restricted Stock Unit Grant Notice, the Award Agreement and the Plan. Participant acknowledges and agrees that this Restricted Stock Unit Grant Notice and the Award Agreement may not be modified, amended or revised except as provided in the Award Agreement and the Plan. Participant further acknowledges that as of the Date of Grant, this Restricted Stock Unit Grant Notice, the Award Agreement and the Plan set forth the entire understanding between Participant and the Company regarding the acquisition of Common Stock pursuant to the Award and supersede all prior oral and written agreements on that subject with the exception, if applicable, of (i) equity awards previously granted and delivered to Participant, (ii) any compensation recovery policy that is adopted by the Company or is otherwise required by applicable law, and (iii) any written employment or severance arrangement that would provide for vesting acceleration of this Award upon the terms and conditions set forth therein.

By accepting this Award, Participant consents to receive such documents by electronic delivery and to participate in the Plan through an on-line or electronic system established and maintained by the Company or a third party designated by the Company.

ROKU, INC.

PARTICIPANT.

By:

Signature

By:

Signature

Title: SVP, Human Resources

By providing an additional signature below or by electronically accepting this Award Agreement pursuant to the Company's instructions to Participant (including through an online acceptance process), Participant declares that he or she expressly agrees with the data processing practices described in Section 14 of the Award Agreement and consents to the collection, processing and use of Data (as defined in Section 14 of the Award Agreement) by the Company and the transfer of Data to the recipients mentioned in Section 14 of the Award Agreement, including recipients located in countries which do not provide an adequate level of protection from a European (or other non-U.S.) data protection law perspective, for the purposes described in Section 14 of the Award Agreement. Participant understands that, as a condition of receiving the Award, Participant must provide his or her signature below or electronically accept this Award, otherwise the Company may forfeit the Restricted Stock Units. Participant understands that he or she may withdraw consent at any time with future effect for any or no reason as described in Section 14 of the Award Agreement.

PARTICIPANT:

Signature

ATTACHMENTS: Award Agreement and 2017 Equity Incentive Plan

ATTACHMENT I
ROKU, INC.
2017 EQUITY INCENTIVE PLAN
RESTRICTED STOCK UNIT AWARD AGREEMENT

Pursuant to the Restricted Stock Unit Grant Notice (the “**Grant Notice**”) and this Restricted Stock Unit Agreement (including any special terms and conditions for your country set forth in the appendix attached hereto as Exhibit A (the “**Appendix**” and, together with the Restricted Stock Unit Award Agreement, the “**Award Agreement**”) Roku, Inc. (the “**Company**”) has awarded you a Restricted Stock Unit Award (the “**Award**”) pursuant to Section 6 of the Company’s 2017 Equity Incentive Plan (the “**Plan**”) for the number of Restricted Stock Units/shares indicated in the Grant Notice. Capitalized terms not explicitly defined in this Award Agreement or the Grant Notice will have the same meanings given to them in the Plan. The terms of your Award, in addition to those set forth in the Grant Notice and the Plan, are as follows.

1. **GRANT OF THE AWARD.** This Award represents the right to be issued on a future date one (1) share of Common Stock for each Restricted Stock Unit that vests on the applicable vesting date(s) (subject to any adjustment under Section 3 below) as indicated in the Grant Notice. As of the Date of Grant, the Company will credit to a bookkeeping account maintained by the Company, or a third party designated by the Company, for your benefit (the “**Account**”) the number of Restricted Stock Units/shares of Common Stock subject to the Award. Except as otherwise provided herein, you will not be required to make any payment to the Company or an Affiliate with respect to your receipt of the Award, the vesting of the Restricted Stock Units or the delivery of the Company’s Common Stock to be issued in respect of the Award. Notwithstanding the foregoing, the Company reserves the right to issue you the cash equivalent of Common Stock, in part or in full satisfaction of the delivery of Common Stock upon vesting of your Restricted Stock Units, and, to the extent applicable, references in this Award Agreement and the Grant Notice to Common Stock issuable in connection with your Restricted Stock Units will include the potential issuance of its cash equivalent pursuant to such right, unless otherwise provided for your country in the Appendix.

2. **VESTING.** Subject to the limitations contained herein, your Award will vest, if at all, in accordance with the vesting schedule provided in the Grant Notice, provided that vesting will cease upon the termination of your Continuous Service. Upon such termination of your Continuous Service, the Restricted Stock Units/shares of Common Stock credited to the Account that were not vested on the date of such termination will be forfeited at no cost to the Company and you will have no further right, title or interest in or to such underlying shares of Common Stock.

For purposes of your Award, your Continuous Service will be considered terminated (regardless of the reason of termination, whether or not later found to be invalid or in breach of employment or other laws or rules in the jurisdiction where you are providing services or the terms of your employment or service agreement, if any) effective as of the date that you cease to actively provide services to the Company or any Affiliate and will not be extended by any notice period (e.g., employment or service would not include any contractual notice period or any period of “garden leave” or similar period mandated under employment or other laws in the jurisdiction where you are employed or providing services or the terms of your employment or service agreement, if any). The Board shall have exclusive discretion to determine when you are no longer actively employed or providing services for purposes of the Plan (including whether you still may be considered to be providing services while on a leave of absence).

3. **NUMBER OF SHARES.** The number of Restricted Stock Units/shares subject to your Award may be adjusted from time to time for Capitalization Adjustments, as provided in the Plan. Any additional

Restricted Stock Units, shares, cash or other property that become subject to the Award pursuant to this Section 3, if any, will be subject, in a manner determined by the Board, to the same forfeiture restrictions, restrictions on transferability, and time and manner of delivery as applicable to the other Restricted Stock Units and shares covered by your Award. Notwithstanding the provisions of this Section 3, no fractional shares or rights for fractional shares of Common Stock will be created pursuant to this Section 3. Any fraction of a share will be rounded down to the nearest whole share.

4. COMPLIANCE. You may not be issued any Common Stock under your Award unless the shares of Common Stock underlying the Restricted Stock Units are either (i) then registered under the Securities Act, or (ii) the Company has determined that such issuance would be exempt from the registration requirements of the Securities Act. Your Award must also comply with other applicable laws and regulations governing the Award, including any U.S. and non-U.S. state, federal and local laws, and you will not receive such Common Stock if the Company determines that such receipt would not be in material compliance with such laws and regulations.

5. TRANSFER RESTRICTIONS. Prior to the time that shares of Common Stock have been delivered to you, you may not transfer, pledge, sell or otherwise dispose of this Award or the shares issuable in respect of your Award, except as expressly provided in this Section 5. For example, you may not use shares that may be issued in respect of your Restricted Stock Units as security for a loan. The restrictions on transfer set forth herein will lapse upon delivery to you of shares in respect of your vested Restricted Stock Units. Notwithstanding the foregoing, if permitted by the Company and valid under applicable law, by delivering written notice to the Company, in a form satisfactory to the Company, you may designate a third party who, in the event of your death, will thereafter be entitled to receive any distribution of Common Stock to which you were entitled at the time of your death pursuant to this Award Agreement. In the absence of such a designation or if such designation is not valid under applicable law, your legal representative will be entitled to receive, on behalf of your estate, such Common Stock or other consideration.

(a) **Death.** Your Award is transferable by will and by the laws of descent and distribution. At your death, vesting of your Award will cease and your executor or administrator of your estate will be entitled to receive, on behalf of your estate, any Common Stock or other consideration that vested but was not issued before your death.

(b) **Domestic Relations Orders.** Upon receiving written permission from the Board or its duly authorized designee, and provided that you and the designated transferee enter into transfer and other agreements required by the Company, you may transfer your right to receive the distribution of Common Stock or other consideration hereunder, pursuant to a domestic relations order, official marital settlement agreement or other divorce or separation instrument that contains the information required by the Company to effectuate the transfer. You are encouraged to discuss the proposed terms of any division of this Award with the Company General Counsel prior to finalizing the domestic relations order or marital settlement agreement to verify that you may make such transfer, and if so, to help ensure the required information is contained within the domestic relations order or marital settlement agreement.

6. DATE OF ISSUANCE.

(a) The issuance of shares in respect of the Restricted Stock Units is intended to comply with Treasury Regulations Section 1.409A-1(b)(4) and will be construed and administered in such a manner. Subject to the satisfaction any withholding obligation for Tax-Related Items (as defined in Section 10 below), in the event one or more Restricted Stock Units vests, the Company will issue to you one (1) share of Common Stock for each Restricted Stock Unit that vests on the applicable vesting date(s) (subject to any adjustment under Section 3 above, and subject to any different provisions in the Grant Notice). The issuance date determined by this paragraph is referred to as the ***"Original Issuance Date"***.

(b) If the Original Issuance Date falls on a date that is not a business day, delivery will instead occur on the next following business day. In addition, if:

(i) the Original Issuance Date does not occur (1) during an “open window period” applicable to you, as determined by the Company in accordance with the Company’s then-effective policy on trading in Company securities, or (2) on a date when you are otherwise permitted to sell shares of Common Stock on an established stock exchange or stock market (including but not limited to under a previously established written trading plan that meets the requirements of Rule 10b5-1 under the Exchange Act and was entered into in compliance with the Company’s policies (a “**10b5-1 Plan**”)), and

(ii) either (1) withholding obligations for Tax-Related Items (as defined in Section 10 below) do not apply, or (2) the Company decides, prior to the Original Issuance Date, (A) not to satisfy the withholding obligation for Tax-Related Items (as defined in Section 10 below) by withholding shares of Common Stock from the shares otherwise due, on the Original Issuance Date, to you under this Award, and (B) not to permit you to enter into a “same day sale” commitment with a broker-dealer pursuant to Section 10 of this Award Agreement (including but not limited to a commitment under a 10b5-1 Plan) and (C) not to permit you to pay the Tax-Related Items in cash or from other compensation otherwise payable to you by the Company (as defined in Section 10 below),

then the shares that would otherwise be issued to you on the Original Issuance Date will not be delivered on such Original Issuance Date and will instead be delivered on the first business day when you are not prohibited from selling shares of the Company’s Common Stock in the open public market, but in no event later than December 31 of the calendar year in which the Original Issuance Date occurs (that is, the last day of your taxable year in which the Original Issuance Date occurs), or, if and only if permitted in a manner that complies with Treasury Regulations Section 1.409A-1(b)(4), no later than the date that is the 15th day of the third calendar month of the applicable year following the year in which the shares of Common Stock under this Award are no longer subject to a “substantial risk of forfeiture” within the meaning of Treasury Regulations Section 1.409A-1(d).

(c) The form of delivery of the shares of Common Stock in respect of your Award (*e.g.*, a stock certificate or electronic entry evidencing such shares) will be determined by the Company.

7. DIVIDENDS. You will receive no benefit or adjustment to your Award with respect to any cash dividend, stock dividend or other distribution that does not result from a Capitalization Adjustment; provided, however, that this sentence will not apply with respect to any shares of Common Stock that are delivered to you in connection with your Award after such shares have been delivered to you.

8. RESTRICTIVE LEGENDS. The shares of Common Stock issued under your Award will be endorsed with appropriate legends as determined by the Company.

9. EXECUTION OF DOCUMENTS. You hereby acknowledge and agree that the manner selected by the Company by which you indicate your consent to your Grant Notice is also deemed to be your execution of your Grant Notice and of this Award Agreement. You further agree that such manner of indicating consent may be relied upon as your signature for establishing your execution of any documents to be executed in the future in connection with your Award.

10. RESPONSIBILITY FOR TAXES.

(a) You acknowledge that, regardless of any action the Company or, if different, your employer (the “**Employer**”) takes with respect to any or all income tax, social insurance, payroll tax, fringe benefit tax, payment on account or other tax related items related to your participation in the Plan and

legally applicable to you ("**Tax-Related Items**"), the ultimate liability for all Tax-Related Items is and remains your responsibility and may exceed the amount actually withheld by the Company or the Employer, if any. You further acknowledge that the Company and the Employer (i) make no representations or undertakings regarding the treatment of any Tax-Related Items in connection with any aspect of your Restricted Stock Units, including, but not limited to, the grant of the Restricted Stock Units, the vesting and settlement of the Restricted Stock Units, the delivery or sale of any shares of Common Stock and the issuance of any dividends, and (ii) do not commit to and are under no obligation to structure the terms of the grant or any aspect of your Award to reduce or eliminate your liability for Tax-Related Items or achieve any particular tax result. You acknowledge and agree that you will not make any claim against the Company, or any of its Officers, Directors, Employees or Affiliates for Tax-Related Items arising from your Award. Further, if you are subject to Tax-Related Items in more than one jurisdiction, you acknowledge that the Company and/or the Employer (or former employer, as applicable) may be required to withhold or account for Tax-Related Items in more than one jurisdiction.

(b) Prior to the relevant taxable or tax withholding event, as applicable, you agree to make adequate arrangements satisfactorily to the Company and/or the Employer to satisfy all Tax-Related Items. In this regard, you authorize the Company and/or the Employer, or their respective agents, at their discretion, to satisfy their withholding obligations with regard to all Tax-Related Items by: (i) withholding from your wages or any other cash compensation otherwise payable to you by the Company and/or the Employer; (ii) causing you to tender a cash payment; (iii) permitting or requiring you to enter into a "same day sale" commitment, if applicable, with a broker-dealer that is a member of the Financial Industry Regulatory Authority (a "**FINRA Dealer**") (pursuant to this authorization and without further consent) whereby you irrevocably elect to sell a portion of the shares to be delivered in connection with your Restricted Stock Units to satisfy the Tax-Related Items and whereby the FINRA Dealer irrevocably commits to forward the proceeds necessary to satisfy the Tax-Related Items directly to the Company and its Affiliates; or (iv) withholding shares of Common Stock from the shares of Common Stock issued or otherwise issuable to you in connection with the Award with a Fair Market Value (measured as of the date shares of Common Stock are issued to you pursuant to Section 6) equal to the amount of such Tax-Related Items; *provided, however* that if you are an Officer, then the Company will withhold a number of shares of Common Stock upon the relevant taxable or tax withholding event, as applicable, unless the use of such withholding method is not feasible under applicable law or has materially adverse accounting consequences, in which case, the obligation for Tax-Related Items may be satisfied by one or a combination of methods (i)-(iii) above. The Company or the Employer may withhold or account for Tax-Related Items by considering applicable statutory withholding amounts or other applicable withholding rates, including maximum rates applicable in your jurisdiction(s), in which case you may receive a refund of any over-withheld amount in cash and will have no entitlement to the Common Stock equivalent. If the obligation for Tax-Related Items is satisfied by withholding in a number of shares of Common Stock, for tax purposes, you will be deemed to have been issued the full number of shares of Common Stock subject to the vested Restricted Stock Units, notwithstanding that a number of the shares of Common Stock is held back solely for the purpose of paying the Tax-Related Items. However, the Company does not guarantee that you will be able to satisfy the Tax-Related Items through any of the methods described in the preceding provisions and in all circumstances you remain responsible for timely and fully satisfying the Tax-Related Items.

(c) Unless the Tax-Related Items of the Company and any Affiliate are satisfied, the Company will have no obligation to deliver to you any Common Stock or other consideration pursuant to this Award.

(d) In the event the Company's obligation to withhold arises prior to the delivery to you of Common Stock or it is determined after the delivery of Common Stock to you that the amount of the Company's withholding obligation was greater than the amount withheld by the Company, you agree to indemnify and hold the Company harmless from any failure by the Company to withhold the proper

amount.

11. AWARD NOT A SERVICE CONTRACT.

(a) Your Continuous Service with the Company, the Employer or any other Affiliate is not for any specified term and may be terminated by you or by the Company, the Employer or any other Affiliate at any time, for any reason, with or without cause and, if permitted under applicable law, with or without notice. Nothing in this Award Agreement (including, but not limited to, the vesting of your Award or the issuance of the shares subject to your Award), the Plan or any covenant of good faith and fair dealing that may be found implicit in this Award Agreement or the Plan will: (i) confer upon you any right to continue in the employ of, or affiliation with the Employer; (ii) constitute any promise or commitment by the Company, the Employer or any other Affiliate regarding the fact or nature of future positions, future work assignments, future compensation or any other term or condition of employment or affiliation; (iii) confer any right or benefit under this Award Agreement or the Plan unless such right or benefit has specifically accrued under the terms of this Award Agreement or Plan; or (iv) deprive the Company or the Employer of the right to terminate you at any time and without regard to any future vesting opportunity that you may have. Finally, the grant of the Award shall not be interpreted as forming an employment or service contract with the Company.

(b) By accepting this Award, you acknowledge and agree that the right to continue vesting in the Award is earned only by continuing as an Employee, Director or Consultant at the will of the Company, the Employer or any other Affiliate and that the Company has the right to reorganize, sell, spin-out or otherwise restructure one or more of its businesses or Affiliates at any time or from time to time, as it deems appropriate (a "**reorganization**"). You further acknowledge and agree that such a reorganization could result in the termination of your Continuous Service, or the termination of Affiliate status of the Employer and the loss of benefits available to you under this Award Agreement, including but not limited to, the termination of the right to continue vesting in the Award. You further acknowledge and agree that this Award Agreement, the Plan, the transactions contemplated hereunder and the vesting schedule set forth herein or any covenant of good faith and fair dealing that may be found implicit in any of them do not constitute an express or implied promise of continued engagement as an employee or consultant for the term of this Award Agreement, for any period, or at all, and will not interfere in any way with your right or the right of the Company, the Employer or any other Affiliate to terminate your Continuous Service at any time, with or without cause and, if permitted under applicable law, with or without notice, and will not interfere in any way with the Company's right to conduct a reorganization.

12. NATURE OF GRANT. In accepting your Award, you acknowledge, understand and agree that:

(a) the Plan is established voluntarily by the Company, it is discretionary in nature and it may be modified, amended, suspended or terminated by the Company at any time, to the extent permitted under the Plan;

(b) the Award is exceptional, voluntary and occasional and does not create any contractual or other right to receive future Awards (whether on the same or different terms), or benefits in lieu of an Award, even if an Award has been granted in the past;

(c) all decisions with respect to future awards of Restricted Stock Units or other grants, if any, will be at the sole discretion of the Company;

(d) you are voluntarily participating in the Plan;

(e) the future value of the shares of Common Stock underlying the Award is unknown, indeterminable and cannot be predicted with certainty;

(f) no claim or entitlement to compensation or damages shall arise from forfeiture of the Award resulting from the termination of your Continuous Service (for any reason whatsoever whether or not later found to be invalid or in breach of employment laws in the jurisdiction where you are employed or rendering services or the terms of your employment agreement, if any);

(g) unless otherwise provided herein, in the Plan or by the Company in its discretion, the Award and the benefits evidenced by this Award Agreement do not create any entitlement to have the Award or any such benefits transferred to, or assumed by, another company nor to be exchanged, cashed out or substituted for, in connection with any corporate transaction affecting the shares of Common Stock;

(h) the Award and the shares of Common Stock subject to the Award, and the income from and value of same, are not part of normal or expected compensation for purposes of, including, without limitation, calculating any severance, resignation, termination, redundancy, dismissal, end-of-service payments, bonuses, long-service awards, pension or retirement or welfare benefits or similar payments;

(i) unless otherwise agreed with the Company, the Award and the shares of Common Stock subject to the Award, and the income from and value of same, are not granted as consideration for, or in connection with, the service you may provide as a director of an Affiliate; and

(j) The following provisions apply only if you are employed or rendering services outside the United States:

(i) the Award and the shares of Common Stock subject to the Award, and the income from and value of same, are not part of normal or expected compensation for any purpose; and

(ii) neither the Company, the Employer nor any other Affiliate shall be liable for any foreign exchange rate fluctuation between your local currency and the United States Dollar that may affect the value of the Award or of any amounts due to you pursuant to the vesting of the Award or the subsequent sale of any shares of Common Stock acquired upon vesting.

13. **NO ADVICE REGARDING GRANT.** The Company is not providing any tax, legal or financial advice, nor is the Company making any recommendations regarding your participation in the Plan, or your acquisition or sale of the underlying shares of Common Stock. You should consult with your own personal tax, financial and/or legal advisors regarding your participation in the Plan before taking any action related to the Plan.

14. **DATA PRIVACY.**

(a) ***Data Collection and Usage.*** The Company and the Employer collect, process and use certain personal information about you, including, but not limited to, your name, home address and telephone number, email address, date of birth, social insurance, passport or other identification number, salary, nationality, job title, any shares of Common Stock or directorships held in the Company, details of all Restricted Stock Units or any other entitlement to shares of Common Stock or equivalent benefits awarded, canceled, exercised, vested, unvested or outstanding in your favor ("Data"), for the purposes of implementing, administering and managing the Plan. The legal basis, where required, for the processing of Data is your consent.

(b) **Stock Plan Administration Service Providers.** The Company will transfer Data to E*TRADE Financial Corporate Services, Inc. (including its affiliated companies) (collectively, the “Designated Broker”), which is assisting the Company with the implementation, administration and management of the Plan. The Company may select different or additional service providers in the future and share Data with such other provider(s) serving in a similar manner. You may be asked to agree on separate terms and data processing practices with the Designated Broker, with such agreement being a condition to the ability to participate in the Plan.

(c) **International Data Transfers.** The Company and the Designated Broker are based in the United States. Your country or jurisdiction may have different data privacy laws and protections than the United States. For example, the European Commission has issued a limited adequacy finding with respect to the United States that applies only to the extent companies register for the EU-U.S. Privacy Shield program. The Company is not currently registered for this program. The Company’s legal basis, where required, for the transfer of Data is your consent.

(d) **Data Retention.** The Company will hold and use Data only as long as is necessary to implement, administer and manage your participation in the Plan, or as required to comply with legal or regulatory obligations, including under tax, exchange control, labor and securities laws.

(e) **Voluntariness and Consequences of Consent Denial or Withdrawal.** Participation in the Plan is voluntary, and you are providing the consents herein on a purely voluntary basis. If you do not consent, or if you later seek to revoke your consent, your salary from or employment and career with the Employer will not be affected; the only consequence of refusing or withdrawing consent is that the Company would not be able to grant the Restricted Stock Units or other equity awards to you or administer or maintain such awards.

(f) **Data Subject Rights.** You may have a number of rights under data privacy laws in your jurisdiction. Depending on where you are based, such rights may include the right to (i) request access or copies of Data the Company processes, (ii) rectification of incorrect Data, (iii) deletion of Data, (iv) restrictions on processing of Data, (v) portability of Data, (vi) lodge complaints with competent authorities in your jurisdiction, and/or (vii) receive a list with the names and addresses of any potential recipients of Data. To receive clarification regarding these rights or to exercise these rights, you can contact the local human resources representative.

(g) **Additional Acknowledgment/Consent.** You understand that the Company may rely on a different basis for the processing or transfer of Data in the future and/or request that you provide another data privacy consent. If applicable, you agree that upon request of the Company or the Employer, you will provide an executed acknowledgement or data privacy consent form (or any other agreements or consents) that the Company and/or the Employer may deem necessary to obtain from you for the purpose of administering your participation in the Plan in compliance with the data privacy laws in your country, either now or in the future. You understand and agree that you will not be able to participate in the Plan if you fail to provide any such consent or agreement requested by the Company and/or the Employer.

15. **UNSECURED OBLIGATION.** Your Award is unfunded, and as a holder of a vested Award, you will be considered an unsecured creditor of the Company with respect to the Company's obligation, if any, to issue shares or other property pursuant to this Award Agreement. You will not have voting or any other rights as a stockholder of the Company with respect to the shares to be issued pursuant to this Award Agreement until such shares are issued to you pursuant to Section 6 of this Award Agreement. Upon such issuance, you will obtain full voting and other rights as a stockholder of the Company. Nothing contained in this Award Agreement, and no action taken pursuant to its provisions, will create or be construed to create a trust of any kind or a fiduciary relationship between you and the Company or any other person.

16. **NOTICES.** Any notice or request required or permitted hereunder will be given in writing to each of the other parties hereto and will be deemed effectively given on the earlier of (i) the date of personal delivery, including delivery by express courier, or delivery via electronic means, or (ii) the date that is five (5) days after deposit in the United States Post Office (whether or not actually received by the addressee), by registered or certified mail with postage and fees prepaid, addressed to the Company at its primary executive offices, attention: Stock Plan Administrator, and addressed to you at your address as on file with the Company at the time notice is given.

17. **HEADINGS.** The headings of the Sections in this Award Agreement are inserted for convenience only and will not be deemed to constitute a part of this Award Agreement or to affect the meaning of this Award Agreement.

18. **GOVERNING PLAN DOCUMENT.** Your Award is subject to all the provisions of the Plan, the provisions of which are hereby made a part of your Award, and is further subject to all interpretations, amendments, rules and regulations which may from time to time be promulgated and adopted pursuant to the Plan. Your Award (and any compensation paid or shares issued under your Award) is subject to recoupment in accordance with The U.S. Dodd-Frank Wall Street Reform and Consumer Protection Act and any implementing regulations thereunder, any clawback policy adopted by the Company and any compensation recovery policy otherwise required by applicable law. No recovery of compensation under such a clawback policy will be an event giving rise to a right to voluntarily terminate employment upon a resignation for "good reason," or for a "constructive termination" or any similar term under any plan of or agreement with the Company.

19. **OTHER DOCUMENTS.** You hereby acknowledge receipt of and the right to receive a document providing the information required by Rule 428(b)(1) promulgated under the Securities Act, which includes the Plan prospectus. In addition, you acknowledge receipt of the Company's policy permitting certain individuals to sell shares only during certain "window" periods and the Company's insider trading policy, in effect from time to time.

20. **SEVERABILITY.** If all or any part of this Award Agreement or the Plan is declared by any court or governmental authority to be unlawful or invalid, such unlawfulness or invalidity will not invalidate any portion of this Award Agreement or the Plan not declared to be unlawful or invalid. Any Section of this Award Agreement (or part of such a Section) so declared to be unlawful or invalid will, if possible, be construed in a manner which will give effect to the terms of such Section or part of a Section to the fullest extent possible while remaining lawful and valid.

21. **LANGUAGE.** If you have received this Award Agreement, or any other document related to this Award and/or the Plan translated into a language other than English and if the meaning of the translated version is different than the English version, the English version will control. You acknowledge that you are sufficiently proficient in English, or have consulted with an advisor who is sufficiently proficient in English, so as to allow you to understand the terms and conditions of this Award Agreement.

22. **INSIDER TRADING RESTRICTIONS/MARKET ABUSE LAWS.** You may be subject to insider trading restrictions and/or market abuse laws based on the exchange on which the shares of Common Stock are listed and in applicable jurisdictions, including the United States and your country or your broker's country, if different, which may affect your ability to accept, acquire, sell or otherwise dispose of shares of Common Stock, rights to shares of Common Stock (e.g., Restricted Stock Units) or rights linked to the value of shares of Common Stock during such times as you are considered to have "inside information" regarding the Company (as defined by the laws in applicable jurisdictions). Local insider trading laws and regulations may prohibit the cancellation or amendment of orders you placed before you possessed inside information. Furthermore, you could be prohibited from (i) disclosing the inside information to any third party, which may include fellow employees and (ii) "tipping" third parties or causing them otherwise to buy or sell securities. Any restrictions under these laws or regulations are separate from and in addition to any restrictions that may be imposed under any applicable insider trading policy of the Company. You acknowledge that it is your responsibility to comply with any applicable restrictions and you should speak with your personal legal advisor on this matter.

23. **FOREIGN ASSET/ACCOUNT AND TAX REPORTING, EXCHANGE CONTROLS.** Your country may have certain foreign asset, account and/or tax reporting requirements and exchange controls which may affect your ability to acquire or hold shares of Common Stock under the Plan or cash received from participating in the Plan (including from any dividends received or sale proceeds arising from the sale of shares of Common Stock) in a brokerage or bank account outside your country. You understand that you may be required to report such accounts, assets or transactions to the tax or other authorities in your country. You also may be required to repatriate sale proceeds or other funds received as a result of participation in the Plan to your country through a designated bank or broker and/or within a certain time after receipt. In addition, you may be subject to tax payment and/or reporting obligations in connection with any income realized under the Plan and/or from the sale of shares of Common Stock. You acknowledge that you are responsible for complying with all such requirements, and that you should consult personal legal and tax advisors, as applicable, to ensure compliance.

24. **APPENDIX.** Notwithstanding any provisions in this Award Agreement, your Award shall be subject to the special terms and conditions for your country set forth in the Appendix attached hereto as Exhibit A. Moreover, if you relocate to one of the countries included therein, the terms and conditions for such country will apply to you to the extent the Company determines that the application of such terms and conditions is necessary or advisable for legal or administrative reasons. The Appendix constitutes part of this Award Agreement.

25. **IMPOSITION OF OTHER REQUIREMENTS.** The Company reserves the right to impose other requirements on your participation in the Plan, and on any shares of Common Stock acquired under the Plan, to the extent the Company determines it is necessary or advisable for legal or administrative reasons, and to require you to sign any additional agreements or undertakings that may be necessary to accomplish the foregoing.

26. **GOVERNING LAW/VENUE.** The interpretation, performance and enforcement of this Award Agreement will be governed by the law of the State of Delaware without regard to that state's conflicts of laws rules. For purposes of any action, lawsuit or other proceedings brought to enforce this Award Agreement, including its Exhibit, relating to it, or arising from it, the parties hereby submit to and consent to the sole and exclusive jurisdiction of the courts within Santa Clara County, State of California, and no other courts, where this grant is made and/or to be performed.

27. **MISCELLANEOUS.:**

(a) The rights and obligations of the Company under your Award will be transferable

by the Company to any one or more persons or entities, and all covenants and agreements hereunder will inure to the benefit of, and be enforceable by, the Company's successors and assigns.

(b) You agree upon request to execute any further documents or instruments necessary or desirable in the sole determination of the Company to carry out the purposes or intent of your Award.

(c) You acknowledge and agree that you have reviewed your Award in its entirety, have had an opportunity to obtain the advice of counsel prior to executing and accepting your Award and fully understand all provisions of your Award.

(d) All obligations of the Company under the Plan and this Award Agreement will be binding on any successor to the Company, whether the existence of such successor is the result of a direct or indirect purchase, merger, consolidation, or otherwise, of all or substantially all of the business and assets of the Company.

28. AMENDMENT. This Award Agreement may not be modified, amended or terminated except by an instrument in writing, signed by you and by a duly authorized representative of the Company. Notwithstanding the foregoing, this Award Agreement may be amended solely by the Board by a writing which specifically states that it is amending this Award Agreement, so long as a copy of such amendment is delivered to you, and provided that, except as otherwise expressly provided in the Plan, no such amendment materially adversely affecting your rights hereunder may be made without your written consent. Without limiting the foregoing, the Board reserves the right to change, by written notice to you, the provisions of this Award Agreement in any way it may deem necessary or advisable to carry out the purpose of the Award as a result of any change in applicable laws or regulations or any future law, regulation, ruling, or judicial decision, provided that any such change will be applicable only to rights relating to that portion of the Award which is then subject to restrictions as provided herein.

29. COMPLIANCE WITH SECTION 409A OF THE CODE. This Award is intended to comply with the "short-term deferral" rule set forth in Treasury Regulation Section 1.409A-1(b)(4). Notwithstanding the foregoing, if it is determined that the Award fails to satisfy the requirements of the short-term deferral rule and is otherwise deferred compensation subject to Section 409A, and if you are a "Specified Employee" (within the meaning set forth in Section 409A(a)(2)(B)(i) of the Code) as of the date of your "separation from service" (within the meaning of Treasury Regulation Section 1.409A-1(h) and without regard to any alternative definition thereunder), then the issuance of any shares that would otherwise be made upon the date of the separation from service or within the first six (6) months thereafter will not be made on the originally scheduled date(s) and will instead be issued in a lump sum on the earlier of: (i) the fifth business day following your death, or (ii) the date that is six (6) months and one day after the date of the separation from service, with the balance of the shares issued thereafter in accordance with the original vesting and issuance schedule set forth above, but if and only if such delay in the issuance of the shares is necessary to avoid the imposition of adverse taxation on you in respect of the shares under Section 409A of the Code. Each installment of shares that vests is intended to constitute a "separate payment" for purposes of Treasury Regulation Section 1.409A-2(b)(2).

* * * * *

This Award Agreement will be deemed to be signed by the Company and you upon your signing or otherwise by your acceptance of the Restricted Stock Unit Grant Notice to which it is attached.

EXHIBIT A

APPENDIX TO RESTRICTED STOCK UNIT AWARD AGREEMENT

SPECIAL TERMS AND CONDITIONS FOR EMPLOYEES OUTSIDE THE UNITED STATES

Capitalized terms used but not defined in this Appendix have the meanings set forth in the Plan and/or in the Restricted Stock Unit Award Agreement.

Terms and Conditions

This Appendix includes special terms and conditions that govern the Restricted Stock Units granted to you under the Plan if you reside and/or work in one of the countries listed below. If you are a citizen or resident (or are considered as such for local law purposes) of a country other than the country in which you are currently residing and/or working, or if you relocate to another country after the grant of the Restricted Stock Units, the Company shall, in its discretion, determine to what extent the special terms and conditions contained herein shall be applicable to you.

Notifications

This Appendix may also include information regarding exchange controls and certain other issues of which you should be aware with respect to participation in the Plan. The information is based on the securities, exchange control, and other laws in effect in the respective countries as of April 2019. Such laws are often complex and change frequently. As a result, the Company strongly recommends that you not rely on the information in this Appendix as the only source of information relating to the consequences of your participation in the Plan because the information may be out of date at the time the Restricted Stock Units vest or you sell shares of Common Stock acquired under the Plan.

In addition, the information contained herein is general in nature and may not apply to your particular situation, and the Company is not in a position to assure you of a particular result. Accordingly, you are advised to seek appropriate professional advice as to how the relevant laws in your country may apply to your situation.

Finally, if you are a citizen or resident (or are considered as such for local law purposes) of a country other than the country in which you are currently residing and/or working, or if you relocate to another country after the grant of the Restricted Stock Units, the notifications contained herein may not be applicable to you in the same manner.

CHINA**Terms and Conditions**

The following provisions assume you are not subject to exchange control regulations in the People's Republic of China ("China"), including the requirements imposed by the State Administration of Foreign Exchange ("SAFE"), as determined by the Company in its sole discretion: If you are subject to exchange control regulations in China, the Company has the right to cancel the Award because settlement of the Award would not be in compliance with applicable regulations in China.

Notifications

Exchange Control Information. Chinese residents must report to SAFE all details of foreign financial assets and liabilities, as well as details of any economic transactions conducted with non-Chinese residents, either directly or through financial institutions.

DENMARK**Terms and Conditions**

Danish Stock Option Act. By accepting this Award, you acknowledge that you received an Employer Statement, translated into Danish, which is being provided to comply with the Danish Stock Option Act.

Please note the Danish Stock Option Act has been revised as of January 1, 2019. The termination provisions under the Plan will apply for any grants made after January 1, 2019. The relevant termination provisions are detailed in Section 2 of the Agreement and the Employer Statement.

Notifications

Securities/Tax Reporting Information. The new Danish Tax Reporting Act that entered into force on January 1, 2019 removed the rules that previously obligated you to inform the Danish Tax Administration about shares of Common Stock held in foreign bank or brokerage accounts and deposit accounts with a foreign bank or broker. The use of the relevant Forms V and K are discontinued as of January 1, 2019 and replaced by automatic exchange of information regarding bank and brokerage accounts.

Foreign Asset/Account Reporting Information. If you establish an account holding shares or cash outside of Denmark, you must report the account to the Danish Tax Administration. The form which should be used to make the report can be obtained from a local bank.

SPECIAL NOTICE FOR EMPLOYEES IN DENMARK
EMPLOYER STATEMENT

Pursuant to Section 3(1) of the Act on Stock Options in employment relations, as amended 1 January 2019 (the “**Stock Option Act**”), you are entitled to receive the following information regarding the restricted stock units granted to you by Roku, Inc. (the “**Company**”) under the Roku, Inc. 2017 Equity Incentive Plan (the “**Plan**”) in a written statement.

This statement contains information applicable to your participation in the Plan, as required under the Stock Option Act, while the other terms and conditions of your restricted stock units (“**Restricted Stock Units**”) are described in detail in the Plan and the Restricted Stock Unit Award Agreement (the “**Agreement**”), both of which have been made available to you. Capitalized terms used but not defined herein shall have the same meanings given to them in the Plan or the Agreement, as applicable.

Section 1 of the Stock Option Act provides that the Stock Option Act only applies to employees. Employees are defined in section 16 of the Stock Option Act as persons who receive remuneration for their personal services in an employment relationship. Persons, including managers, who are not regarded as employees under the Stock Option Act, will not be subject to the Stock Option Act. If you are not an employee within the meaning of the Stock Option Act, the Company therefore has no obligation to issue an employer information statement to you and you will not be able to rely on this statement for legal purposes, since only the terms and conditions set out in the Plan apply.

1. Date of grant

The date of grant of your Restricted Stock Units is the date that the Board or Committee approved a grant for you and determined it would be effective, which is set forth in the Agreement.

2. Terms or conditions for Restricted Stock Unit grant

The grant of Restricted Stock Units under the Plan is made at the sole discretion of the Company. Employees, Directors and Consultants of the Company and its Affiliates, are eligible to receive grants under the Plan. The Board has broad discretion to determine who will receive Restricted Stock Units and to set the terms and conditions of the Restricted Stock Units. The Company may decide, in its sole discretion, not to make any grants of Restricted Stock Units to you in the future. Under the terms of the Plan and the Agreement, you have no entitlement or claim to receive future grants of Restricted Stock Units.

3. Vesting date or period

The Restricted Stock Units will vest over a period of time (as set forth in the Agreement), subject to your Continuous Service through the applicable vesting date and other conditions set forth in the Plan and Agreement.

4. Exercise Price

No exercise price is payable upon the conversion of your Restricted Stock Units into shares in accordance with the vesting and settlement schedule described in the Agreement.

5. Your rights upon termination of employment

Vesting will cease upon termination of your Continuous Service and the Restricted Stock Units credited to the Account that were not vested on the date of such termination will be forfeited at no cost to the Company and you will have no further right, title or interest in or to such Award or the shares of Common Stock to be issued in respect of such portion of the Award.

6. Financial aspects of participating in the Plan

The grant of Restricted Stock Units has no immediate financial consequences for you. The value of the Restricted Stock Units is not taken into account when calculating holiday allowances, pension contributions or other statutory consideration calculated on the basis of salary.

Shares of stock are financial instruments and investing in stock will always have financial risk. The future value of Company shares is unknown and cannot be predicted with certainty.

Roku, Inc.

150 Winchester Circle
Los Gatos, CA 95032
U.S.A.

SÆRLIG MEDDELELSE TIL MEDARBEJDERE I DANMARK
ARBEJDSGIVERERKLÆRING

I henhold til § 3, stk. 1, i lov om brug af køberet eller tegningsret mv. i ansættelsesforhold, som ændret 1. januar 2019, ("Aktieoptionsloven") er du berettiget til i en skriftlig erklæring at modtage følgende oplysninger om de betingede aktie (på engelsk: *Restricted Stock Units*), som du tildeles af Roku, Inc. ("Selskabet") i henhold til Roku, Inc.'s 2017 Equity Incentive Plan ("Planen").

Denne erklæring indeholder, i henhold til Aktieoptionsloven, de oplysninger, der er gældende for din deltagelse i Planen, mens de øvrige kriterier og betingelser for dine betingede aktie ("Betingede Aktier") er beskrevet nærmere i Planen og i Restricted Stock Unit Award Agreement ("Aftalen"), som begge er stillet til rådighed for dig. Begreber, der står med stort begyndelsesbogstav i denne arbejdsgivererklæring, men som ikke er defineret heri, har den betydning, der er defineret i Planen, hhv. Aftalen.

I henhold til Aktieoptionslovens § 1 finder loven kun anvendelse for lønmodtagere. Lønmodtagere er defineret i Aktieoptionslovens § 16 som personer, der modtager vederlag for personligt arbejde i tjenesteforhold.

Personer, herunder direktører, som ikke anses for at være lønmodtagere i Aktieoptionslovens forstand, er ikke omfattet af Aktieoptionsloven. Hvis du ikke er lønmodtager i Aktieoptionslovens forstand, er Selskabet derfor ikke forpligtet til at udstede en arbejdsgivererklæring til dig, og du vil ikke i juridisk henseende kunne henholde dig til denne arbejdsgivererklæring, da alene Planens vilkår er gældende.

1. Tildelingstidspunkt

Tidspunktet for tildelingen af dine Betingede Aktier er den dag, hvor Bestyrelsen eller Komitéen godkendte din tildeling og besluttede, at den skulle træde i kraft. Tidspunktet fremgår af Aftalen.

2. Vilkår og betingelser for tildelingen af Betingede Aktier

Betingede Aktier, der er omfattet af Planen, tildeles udelukkende efter Selskabets skøn. Tildeling kan i henhold til Planen ske til Medarbejdere, Bestyrelsesmedlemmer og Konsulenter i Selskabet og dets Tilknyttede Selskaber. Bestyrelsen har vide beføjelser til at bestemme, hvem der skal modtage Betingede Aktier og til at fastsætte betingelserne for de Betingede Aktier. Selskabet kan frit vælge fremover ikke at tildele dig Betingede Aktier. I henhold til bestemmelserne i Planen og Aftalen har du hverken ret til eller krav på fremover at få tildelt Betingede Aktier.

3. Modningstidspunkt eller -periode

De Betingede Aktier modnes over en periode (som anført i Aftalen), forudsat at du på det relevante modningstidspunkt opfylder betingelsen om Fortsat Ansættelse og de øvrige betingelser i Planen og i Aftalen.

4. Udnyttelseskurs

Ingen udnyttelsespris skal betales ved din omdannelse af dine Betingede Aktier til Aktier i Selskabet i overensstemmelse med modnings- og udnyttelsesplanen beskrevet i Aftalen.

5. Din retsstilling i forbindelse med fratræden

Ophører modning ved ophør af din Fortsatte Ansættelse, og Betingede Aktier krediteret Kontoen,

som på tidspunktet for ophøret ikke er modnet, bortfalder uden omkostninger for Selskabet, og du vil ikke længere have nogen ejerrettigheder eller rettigheder i øvrigt i forhold til den pågældende Tildeling eller de Aktier, der ellers ville have skullet udstedes på grundlag af den pågældende del af Tildelingen.

6. Økonomiske aspekter ved deltagelse i Planen

Tildelingen af Betingede Aktier har ingen umiddelbare økonomiske konsekvenser for dig. Værdien af de Betingede Aktier indgår ikke i beregningen af feriepenge, pensionsbidrag eller øvrige lovbestemte, vederlagsafhængige ydelser.

Aktier er finansielle instrumenter, og investering i aktier vil altid være forbundet med en økonomisk risiko. Den fremtidige værdi af Selskabets aktier kendes ikke og kan ikke forudsiges med sikkerhed.

Roku, Inc.

150 Winchester Circle
Los Gatos, CA 95032
U.S.A.

GERMANY**Notifications**

Exchange Control Information. Cross-border payments in excess of €12,500 must be reported monthly to the German Federal Bank (*Bundesbank*). In case of payments in connection with securities (including proceeds realized upon the sale of shares of Common Stock or the receipt of dividends), the report must be made by the 5th day of the month following the month in which the payment was received. The report must be filed electronically and the form of report ("*Allgemeine Meldeportal Statistik*") can be accessed via the Bundesbank's website (www.bundesbank.de), in both German and English. You are responsible for making this report.

Foreign Asset/Account Reporting Information. German residents holding shares of Common Stock must notify their local tax office of the acquisition of shares of Common Stock when they file their tax returns for the relevant year if the value of the shares of Common Stock acquired exceeds €150,000 or in the unlikely event that the resident holds Common Stock exceeding 10% of the Company's total Common Stock outstanding.

NEW ZEALAND**Notifications**

Securities Law Notice. *WARNING: You are being offered an Award which allows you to acquire shares of Common Stock in accordance with the terms of the Plan and the Award Agreement. The shares of Common stock, if issued, give you a stake in the ownership of the Company. You may receive a return if dividends are paid.*

If the Company runs into financial difficulties and is wound up, you will be paid only after all creditors have been paid. You may lose some or all of your investment.

New Zealand law normally requires people who offer financial products to give information to investors before they invest. This information is designed to help investors to make an informed decision.

The usual rules do not apply to this offer because it is made under an employee share purchase scheme. As a result, you may not be given all the information usually required. You will also have fewer other legal protections for this investment.

Ask questions, read all documents carefully, and seek independent financial advice before committing yourself.

The shares of Common Stock are quoted on the Nasdaq Global Select Market ("Nasdaq"). This means that, if you acquire shares of Common Stock under the Plan, you may be able to sell your investment on the Nasdaq if there are interested buyers. You may get less than your investment. The price will depend on the demand for the shares of Common Stock.

For information on risk factors impacting the Company's business that may affect the value of the shares of Common Stock, you should refer to the risk factors discussion in the Company's annual report on Form 10-K and quarterly reports on Form 10-Q, which are filed with the U.S. Securities and

Exchange Commission and are available online at www.sec.gov, as well as on the Company's website at <https://ir.roku.com/financial-information/sec-filings>.

NETHERLANDS

There are no country-specific terms.

UNITED KINGDOM

Terms and Conditions

Restricted Stock Units Settled Only in Shares

Notwithstanding any discretion in Section 6(b)(iii) of the Plan or Section 1 of the Award Agreement, Restricted Stock Units shall be settled in shares only.

Responsibility for Taxes. The following supplements Section 10 of the Award Agreement:

Without limitation to Section 10 of the Award Agreement, you agree that you are liable for all Tax-Related Items and hereby covenant to pay all such Tax-Related Items, as and when requested by the Company or the Employer or by Her Majesty's Revenue and Customs ("**HMRC**") (or any other tax authority or any other relevant authority). You also agree to indemnify and keep indemnified the Company and the Employer against any Tax-Related Items that they are required to pay or withhold or have paid or will pay to HMRC on your behalf (or any other tax authority or any other relevant authority).

Notwithstanding the foregoing, if you are a director or an executive officer of the Company (within the meaning of such terms for purposes of Section 13(k) of the Exchange Act), you acknowledge that you may not be able to indemnify the Company or the Employer for the amount of any income tax not collected from or paid by you, as it may be considered a loan. In this case, the amount of any income tax not collected within ninety (90) days of the end of the U.K. tax year in which the event giving rise to the Tax-Related Item(s) occurs may constitute an additional benefit to you on which additional income tax and National Insurance contributions may be payable. You will be responsible for reporting and paying any income tax due on this additional benefit directly to HMRC under the self-assessment regime and for reimbursing the Company or the Employer (as appropriate) for the value of any National Insurance contributions due on this additional benefit, which the Company or the Employer may recover from you by any of the means referred to in the Plan or Section 10 of the Award Agreement.

Joint Election. As a condition of participation in the Plan, you agree to accept any liability for secondary Class 1 National Insurance contributions that may be payable by the Company or the Employer (or any successor to the Company or the Employer) in connection with the Restricted Stock Units and any event giving rise to Tax-Related Items (the "**Employer NICs**"). The Employer NICs may be collected by the Company or the Employer using any of the methods described in the Plan or in Section 10 of the Restricted Stock Unit Award Agreement.

Without prejudice to the foregoing, you agree to execute a joint election with the Company and/or the Employer (a "**Joint Election**"), the form of such Joint Election being formally approved by HMRC, and any other consent or elections required by the Company or the Employer in respect of the Employer NICs liability. You further agree to execute such other elections as may be required by any successor to the Company and/or the Employer for the purpose of continuing the effectiveness of your Joint Election.

**ROKU, INC.
2017 EQUITY INCENTIVE PLAN**

Onscreen disclaimer

As a condition of participation in the Roku, Inc. 2017 Equity Incentive Plan (the “**Plan**”), Participant is required to enter into an Election to transfer to Participant any liability for employer’s National Insurance contributions (“**NICs**”) that may arise in connection with his or her participation in the Plan.

Clicking on the [“ACCEPT”] box indicates Participant’s acceptance of the Election. Participant should read the “Important Note on the Election to Transfer Employer NICs” before accepting the Election.

Important Note on the Election to Transfer Employer NICs

As a condition of participation in the Roku, Inc. 2017 Equity Incentive Plan (the “**Plan**”), Participant is required to enter into an Election to transfer to Participant any liability for employer’s National Insurance contributions (“**NICs**”) that may arise in connection with his or her participation in the Plan.

By entering into the Election:

- Participant agrees that any employer’s NICs liability that may arise in connection with his or her participation in the Plan will be transferred to Participant;
- Participant authorizes his or her employer to recover an amount sufficient to cover this liability by such methods including, but not limited to, deductions from Participant’s wages or other cash compensation due or the sale of sufficient shares of Common Stock acquired pursuant to Participant’s awards; and
- Participant acknowledges that even if Participant has clicked on the [“ACCEPT”] box where indicated, the Company or Participant’s employer may still require Participant to sign a paper copy of this Election (or a substantially similar form) if the Company determines such is necessary to give effect to the Election.

Please read the Election carefully.

Participant Should Print and Keep a Copy of this Election for his or her Records.

ROKU, INC.
2017 EQUITY INCENTIVE PLAN

Election to Transfer the Employer's National Insurance Liability to Participant

This Election is between:

- A. The individual who has obtained authorized access to this Election ("**Participant**"), who is employed by the company listed in the attached schedule (the "**Employer**") and who is eligible to receive restricted stock units ("**Awards**") pursuant to the Roku, Inc. 2017 Equity Incentive Plan (the "**Plan**"), and
- B. Roku, Inc., with its registered office at 12980 Saratoga Avenue, Suite D, Saratoga California, 95070, United States (the "**Company**"), which may grant Awards under the Plan and is entering into this Election on behalf of the Employer.

1. Introduction

1.1 This Election relates to all Awards granted to Participant under the Plan up to the termination date of the Plan.

1.2 In this Election the following words and phrases have the following meanings:

- (a) "**Chargeable Event**" means, in relation to the Awards:
 - (i) the acquisition of securities pursuant to the Awards (within section 477(3)(a) of ITEPA 16003);
 - (ii) the assignment (if applicable) or release of the Awards in return for consideration (within section 477(3)(b) of ITEPA 16003);
 - (iii) the receipt of a benefit in connection with the Awards, other than a benefit within (i) or (ii) above (within section 477(3)(c) of ITEPA 16003);
 - (iv) post-acquisition charges relating to the Awards and/or shares of Common Stock acquired pursuant to the Awards (within section 4167 of ITEPA 16003); and/or
 - (v) post-acquisition charges relating to the Awards and/or shares of Common Stock acquired pursuant to the Awards (within section 439 of ITEPA 16003).
- (b) "**ITEPA 16003**" means the Income Tax (Earnings and Pensions) Act 16003.
- (c) "**SSCBA**" means the Social Security Contributions and Benefits Act 19916.

2.

- 1.3 This Election relates to the employer's secondary Class 1 National Insurance contributions (the "**Employer's Liability**") which may arise on the occurrence of a Chargeable Event in respect of the Awards pursuant to section 4(4)(a) and/or paragraph 3B(1A) of Schedule 1 of the SSCBA.
- 1.4 This Election does not apply in relation to any liability, or any part of any liability, arising as a result of regulations being given retrospective effect by virtue of section 4B(16) of either the SSCBA, or the Social Security Contributions and Benefits (Northern Ireland) Act 19916.
- 1.5 This Election does not apply to the extent that it relates to relevant employment income which is employment income of the earner by virtue of Chapter 3A of Part VII of ITEPA 16003 (employment income: securities with artificially depressed market value).

2. The Election

Participant and the Company jointly elect that the entire liability of the Employer to pay the Employer's Liability on the Chargeable Event is hereby transferred to Participant. Participant understands that, by signing or electronically accepting this Election, he or she will become personally liable for the Employer's Liability covered by this Election. This Election is made in accordance with paragraph 3B(1) of Schedule 1 of the SSCBA.

3. Payment of the Employer's Liability

- 3.1 Participant hereby authorizes the Company and/or the Employer to collect the Employer's Liability from Participant at any time after the Chargeable Event:
 - (i) by deduction from salary or any other payment payable to Participant at any time on or after the date of the Chargeable Event; and/or
 - (ii) directly from Participant by payment in cash or cleared funds; and/or
 - (iii) by arranging, on behalf of Participant, for the sale of some of the securities which Participant is entitled to receive in respect of the Awards; and/or
 - (iv) by any other means specified in the applicable award agreement.
- 3.2 The Company hereby reserves for itself and the Employer the right to withhold the transfer of any securities related to the Awards to Participant until full payment of the Employer's Liability is received.
- 3.3 The Company agrees to procure the remittance by the Employer of the Employer's Liability to Her Majesty's Revenue & Customs on behalf of Participant within 14 days after the end of the U.K. tax month during which the Chargeable Event occurs (or within 17 days after the end of the U.K. tax month during which the Chargeable Event occurs if payments are made electronically).

3.

4. Duration of Election

- 4.1 Participant and the Company agree to be bound by the terms of this Election regardless of whether Participant is transferred abroad or is not employed by the Employer on the date on which the Employer's Liability becomes due.
- 4.2 Any reference to the Company and/or the Employer shall include that entity's successors in title and assigns as permitted in accordance with the terms of the Plan and relevant award agreement. This Election will continue in effect in respect of any awards which replace the Awards in circumstances where section 483 of ITEPA 16003 applies.
- 4.3 This Election will continue in effect until the earliest of the following:
- (i) Participant and the Company agree in writing that it should cease to have effect;
 - (ii) on the date the Company serves written notice on Participant terminating its effect;
 - (iii) on the date Her Majesty's Revenue & Customs withdraws approval of this Election; or
 - (iv) after due payment of the Employer's Liability in respect of the entirety of the Awards to which this Election relates or could relate, such that the Election ceases to have effect in accordance with its terms.
- 4.4 This Election will continue in force regardless of whether Participant ceases to be an employee of the Employer.
- [Signature page follows]**

Acceptance by Participant

Participant acknowledges that, by clicking on the "ACCEPT" box, Participant agrees to be bound by the terms of this Election.

Acceptance by the Company

The Company acknowledges that, by signing this Election or arranging for the scanned signature of an authorized representative to appear on this Election, the Company agrees to be bound by the terms of this Election.

Signature for and on behalf of the Company _____

Position _____

Schedule of Employer Companies

The employer companies to which this Election relates are:

Name	Roku Europe Limited
Registered Office:	11th Floor, Whitefriars Lewins Mead, Bristol, BS1 16NT, UK
Company Registration Number:	091633680
Corporation Tax Reference:	6163 164460 1641681
PAYE Reference:	1160/FB116365



January 17, 2019

Mustafa Ozgen

Dear Mustafa,

On behalf of Roku, Inc. (the "Company"), I am very pleased to offer you employment with the Company. The following Employment Terms Agreement (the "Agreement") sets forth the terms and conditions of your employment relationship with the Company.

Employment Terms Agreement

1. Position and Start Date.

- a. **Position: Senior Vice President & General Manager, Account Acquisition**, reporting to **Anthony Wood, Founder, Chairman and Chief Executive Officer**, working out of the Los Gatos, California office location (and after the Company's relocation from Los Gatos to San Jose, the San Jose, California office location). The Company has the discretion to modify your position, duties, reporting relationship and office location from time to time.
- b. You will relocate to the Bay Area as soon as practical, but no later than 12 months, following your start date.
- c. **Start date: February 11, 2018**

2. Compensation.

- a. **Total Compensation Package.** Subject to approval of the Company's Compensation Committee, you will have an annual compensation package of \$2,500,000. **Total Compensation is defined as cash and equity value.** The details of each component are listed below:

Annual Cash:	\$875,000
One-Year Equity Value:	\$1,625,000 ¹
Total Annual Compensation:	\$2,500,000

¹ Due to stock price fluctuations, your actual one-year equity value and your actual four-year equity value may be more or less than this amount.

Your initial equity grant will consist of an equity incentive award vesting over four years with an aggregate value of **\$6,500,000¹**.

- i. **Cash.** Your annual cash compensation will be **\$875,000.00** (or \$33,653.85 per bi-weekly pay period), payable in accordance with the Company's standard payroll practice and subject to applicable payroll deductions and all required withholdings. Because your position is exempt from overtime pay, your salary will compensate you for all hours worked. You will receive your full salary in any workweek that you perform work subject to deductions permitted by law as applicable to your status as a salaried exempt employee.
- ii. **Equity Incentive.** As mentioned above and subject to approval by the Company's Compensation Committee, you will be granted an equity incentive award under the Roku, Inc. 2017 Equity Incentive Plan (the "Plan") vesting over four years with an aggregate value of **\$6,500,000¹**.

As **Senior Vice President & General Manager, Account Acquisition**, you will be offered a choice regarding the form of the initial equity incentive award being made to you. At your election, you may receive your equity incentive award as:

- 100% stock options: As an option to purchase shares of common stock at a set price; or
- 100% restricted stock units: As an award to receive shares of common stock; or
- 50% stock options and 50% restricted stock units.

An election form that details the method for converting the value of your equity incentive award into your election of stock options and/or restricted stock units will be provided to you after your start date, and prior to the proposed grant date.

- iii. **Starting Bonus.** Contingent upon you signing on or before **January 23, 2019**, you will receive a starting bonus of **\$100,000** to be paid to you in the first pay date after 30 days of your start date, less applicable payroll deductions and all required withholdings. You must remain an employee in good standing to be eligible for the bonus and should you resign within 12 months of your start date or you do not relocate to the [Los Gatos, CA] area within 12 months, the entire bonus will be owed back to the Company.
- b. **Relocation Assistance.** Roku will provide you with relocation services from Lexington, MA to Los Gatos, CA in the amount up to **\$60,000** through our third-party, relocation provider Move Center. Roku Inc. will not gross-up the relocation amount to cover the applicable taxes. The relocation assistance is available to you to use within 12 months of your start date. You must remain an employee in good standing to be eligible for the relocation assistance and should you resign within 12 months of your start date, the entire relocation expenses paid will be owed back to the Company. **Certain expenses may be subject to taxation in accordance with federal, state and local tax laws and regulation. Please consult with your tax advisor regarding the potential impact of moving and relocation benefits as taxable income.**

- c. **Severance Benefits.** Your severance benefits and equity acceleration shall be as set forth in the Roku, Inc. Severance Benefit Plan, with an effective date as of May 17, 2016.
- d. **Compensation Review.** Your compensation plan will be reviewed as part of the Company's normal salary review process. The Company retains the discretion to modify your compensation terms at any time.

3. Benefits.

- a. **Insurance Benefits.** Subject to the terms, conditions and limitations of the Company's benefit plans, you will be eligible to participate in the Company's standard employee insurance benefits which currently consist of a 401(k) Plan, medical, dental, vision, life and disability insurance coverage plans. Generally, you are eligible to enroll in our 401(k) and major medical plans as of the date of your start of employment.
- b. **Paid Time Off.** You will be subject to the Company's Time Off and Leave of Absence Policy, a copy of which will be provided to you prior to or on your employment start date.

The Company retains the discretion to modify your benefits and Company policies at any time.

4. Employee Proprietary Information and Inventions Agreement; Protection of Third Party Information. As an employee of the Company, you will have access to certain Company confidential information and you may, during the course of your employment, develop certain information or inventions which will be the property of the Company. To protect the interest of the Company, you will need to sign and comply with the Company's standard "Employee Proprietary Information and Inventions Agreement" as a condition of your employment. The Employee Proprietary Information and Inventions Agreement is enclosed with this Agreement. In your work for the Company, you are expected not to make unauthorized use or disclosure of any confidential or proprietary information or materials, including trade secrets, of any former employer or other third party to whom you have an obligation of confidentiality. Rather, you will be expected to use only that information which is generally known and used by persons with training and experience comparable to your own, which is common knowledge in the industry or otherwise legally in the public domain, or which is otherwise provided or developed by the Company or by you in the course of your employment. By signing this Agreement, you represent that you are able to perform your job duties within these guidelines, and you are not in unauthorized possession of any confidential documents or other property of any former employer or other third party. In addition, you hereby represent that you have disclosed to the Company in writing any agreement you may have with any third party (e.g., a former employer) which may conflict with or limit your ability to perform your duties to the Company.

5. At-Will Employment. Your employment with the Company is "at will." You may terminate your employment at any time by notifying the Company. Likewise, the Company may terminate your employment at any time, with or without cause, and with or without advance notice.

6. Background Investigations and Background Checks. The Company reserves the right to conduct background investigations and/or reference checks on all of its potential employees. Your job offer, therefore, is contingent upon a satisfactory clearance of such a background investigation and/or reference check, if any.

7. **Entire Agreement.** This Agreement, together with your Employee Proprietary Information and Inventions Agreement, forms the complete and exclusive statement of your employment agreement with Company. The employment terms in this Agreement supersede any other agreements or promises made to you by anyone, whether oral or written. Other than those changes expressly reserved to the Company's discretion in this Agreement, this Agreement cannot be changed except in a writing signed by you and a duly authorized officer of the Company. As required by law, this offer is subject to satisfactory proof of your identity and legal right to work in the United States within three (3) business days after your date of hire. If you are unable to provide documentation of your authorization to work in the United States, Roku may withdraw this offer of employment.

To indicate your acceptance of our offer, please sign and date this Agreement in the space provided below, and sign and date the enclosed Employee Proprietary Information and Inventions Agreement, and return both fully signed documents to me no later than the close of business on **January 23, 2019**. The Company's offer will expire if we do not receive these fully signed documents within the aforementioned timeframe.

We look forward to your favorable reply and to a productive and enjoyable work relationship.

Very truly yours,

/s/ Anthony Wood
Anthony Wood
Founder, Chairman and Chief Executive Officer
Roku, Inc.

Enclosures: Employee Proprietary Information and Inventions Agreement
Severance Benefit Plan

UNDERSTOOD AND AGREED:

Mustafa Ozgen

/s/ Mustafa Ozgen
Signature

January 18, 2019
Date

List of subsidiaries of Roku, Inc.

Subsidiary Name	Jurisdiction
Purple Tag Productions LLC	Delaware, United States
Roku Europe Limited	United Kingdom
Purple Tag Media Technology (Shanghai Ltd)	China
Roku Denmark ApS	Denmark
Roku Technologies International Limited	Ireland
Roku Netherlands B.V.	Netherlands
Roku Holdings, Inc.	Delaware, United States
Roku DX Holdings, Inc.	Delaware, United States
DataXu India Private Limited	India
Roku DX UK Ltd	United Kingdom

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We consent to the incorporation by reference in Registration Statement Nos. 333-230039, 333-223379, and 333-220701 on Form S-8 of our reports dated February 28, 2020, relating to the consolidated financial statements of Roku, Inc. and subsidiaries (the "Company"), and the effectiveness of the Company's internal control over financial reporting, appearing in this Annual Report on Form 10-K for the year ended December 31, 2019.

/s/ DELOITTE & TOUCHE LLP

San Jose, California

February 28, 2020

POWER OF ATTORNEY

KNOW ALL PERSONS BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints Anthony Wood and Steve Louden, and each of them, as his or her true and lawful attorneys-in-fact and agents, with full power of substitution and resubstitution, for him and in his name, place, and stead, in any and all capacities, to sign any and all amendments to this Annual Report on Form 10-K, and to file the same, with all exhibits thereto, and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorneys-in-fact and agents, and each of them, full power and authority to do and perform each and every act and thing requisite and necessary to be done in connection therewith, as fully to all intents and purposes as he might or could do in person, hereby ratifying and confirming that all said attorneys-in-fact and agents, or any of them or their or his substitute or substitutes, may lawfully do or cause to be done by virtue hereof.

Pursuant to the requirements of the Securities Exchange Act of 1934, as amended, this Annual Report has been signed below by the following persons on behalf of the Registrant in the capacities and on the dates indicated.

Name	Title	Date
/s/ ANTHONY WOOD Anthony Wood	President, Chief Executive Officer and Chairman (Principal Executive Officer)	February 28, 2020
/s/ STEVE LOUDEN Steve Louden	Chief Financial Officer (Principal Financial Officer)	February 28, 2020
Ravi Ahuja	Director	
/s/ MAI FYFIELD Mai Fyfield	Director	February 28, 2020
/s/ JEFFREY HASTINGS Jeffrey Hastings	Director	February 28, 2020
/s/ ALAN HENRICKS Alan Henricks	Director	February 28, 2020
/s/ NEIL HUNT Neil Hunt	Director	February 28, 2020
/s/ RAY ROTHROCK Ray Rothrock	Director	February 28, 2020

**CERTIFICATION OF CHIEF EXECUTIVE OFFICER
PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Anthony Wood, certify that:

1. I have reviewed this Annual Report on Form 10-K of Roku, Inc.;
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:
 - (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;
 - (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;
 - (c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
 - (d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: February 28, 2020

/s/ Anthony Wood

Anthony Wood
President and Chief Executive Officer
(Principal Executive Officer)

**CERTIFICATION OF CHIEF FINANCIAL OFFICER
PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Steve Loudon, certify that:

1. I have reviewed this Annual Report on Form 10-K of Roku, Inc.;
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:
 - (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;
 - (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;
 - (c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
 - (d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
 - (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
 - (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: February 28, 2020

/s/ Steve Loudon

Steve Loudon
Chief Financial Officer
(Principal Financial Officer)

**CERTIFICATION OF CHIEF EXECUTIVE OFFICER
PURSUANT TO 18 U.S.C. SECTION 1350, AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002**

I, Anthony Wood, do hereby certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, to my knowledge:

The Annual Report on Form 10-K of Roku, Inc. for the year ended December 31, 2019, as filed with the Securities and Exchange Commission (the "Report"), fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

The information contained in such Report fairly presents, in all material respects, the financial condition and results of operations of Roku, Inc.

Date: February 28, 2020

/s/ Anthony Wood

Anthony Wood
President and Chief Executive Officer
(Principal Executive Officer)

**CERTIFICATION OF CHIEF FINANCIAL OFFICER
PURSUANT TO 18 U.S.C. SECTION 1350, AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002**

I, Steve Loudon, do hereby certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, to my knowledge:

The Annual Report on Form 10-K of Roku, Inc. for the year ended December 31, 2019, as filed with the Securities and Exchange Commission (the "Report"), fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

The information contained in such Report fairly presents, in all material respects, the financial condition and results of operations of Roku, Inc.

Date: February 28, 2020

/s/ Steve Loudon

Steve Loudon
Chief Financial Officer
(Principal Financial Officer)

AO 88B (Rev. 02/14) Subpoena to Produce Documents, Information, or Objects or to Permit Inspection of Premises in a Civil Action

UNITED STATES DISTRICT COURT

for the
Eastern District of Texas

Canon, Inc.

Plaintiff

v.

TCL Electronics Holdings Ltd., et al.

Defendant

Civil Action No. 2:18-cv-00546-JRG

SUBPOENA TO PRODUCE DOCUMENTS, INFORMATION, OR OBJECTS
OR TO PERMIT INSPECTION OF PREMISES IN A CIVIL ACTION

To:

Roku Inc. c/o Corporation Service Company
211 E. 7th St, Suite 620, Austin, TX 78701

(Name of person to whom this subpoena is directed)

☒ **Production:** **YOU ARE COMMANDED** to produce at the time, date, and place set forth below the following documents, electronically stored information, or objects, and to permit inspection, copying, testing, or sampling of the material:

See Attachment B

Place: Paul Hastings LLP, 1117 S. California Ave., Palo Alto, CA 94304 or at a mutually agreeable time, date and location	Date and Time: 01/24/2020 6:00 pm
---	--

☐ **Inspection of Premises:** **YOU ARE COMMANDED** to permit entry onto the designated premises, land, or other property possessed or controlled by you at the time, date, and location set forth below, so that the requesting party may inspect, measure, survey, photograph, test, or sample the property or any designated object or operation on it.

Place:	Date and Time:
--------	----------------

The following provisions of Fed. R. Civ. P. 45 are attached – Rule 45(c), relating to the place of compliance; Rule 45(d), relating to your protection as a person subject to a subpoena; and Rule 45(e) and (g), relating to your duty to respond to this subpoena and the potential consequences of not doing so.

Date: 12/20/2019

CLERK OF COURT

OR

Signature of Clerk or Deputy Clerk

/s/ Yar Chaikovsky

Attorney's signature

The name, address, e-mail address, and telephone number of the attorney representing (name of party) Canon, Inc.
who issues or requests this subpoena, are: Yar Chaikovsky, Paul Hastings LLP,
1117 S. California Ave., Palo Alto, CA 94304, yarchaikovsky@paulhastings.com, (650) 320-1800

Notice to the person who issues or requests this subpoena

If this subpoena commands the production of documents, electronically stored information, or tangible things or the inspection of premises before trial, a notice and a copy of the subpoena must be served on each party in this case before it is served on the person to whom it is directed. Fed. R. Civ. P. 45(a)(4).

AO 88B (Rev. 02/14) Subpoena to Produce Documents, Information, or Objects or to Permit Inspection of Premises in a Civil Action (Page 2)

Civil Action No. 2:18-cv-00546-JRG

PROOF OF SERVICE

(This section should not be filed with the court unless required by Fed. R. Civ. P. 45.)

I received this subpoena for *(name of individual and title, if any)* _____
on *(date)* _____.

☐ I served the subpoena by delivering a copy to the named person as follows: _____
_____ on *(date)* _____; or

☐ I returned the subpoena unexecuted because: _____
_____.

Unless the subpoena was issued on behalf of the United States, or one of its officers or agents, I have also
tendered to the witness the fees for one day's attendance, and the mileage allowed by law, in the amount of
\$ _____.

My fees are \$ _____ for travel and \$ _____ for services, for a total of \$ 0.00.

I declare under penalty of perjury that this information is true.

Date: _____

Server's signature

Printed name and title

Server's address

Additional information regarding attempted service, etc.:

Federal Rule of Civil Procedure 45 (c), (d), (e), and (g) (Effective 12/1/13)**(c) Place of Compliance.**

(1) For a Trial, Hearing, or Deposition. A subpoena may command a person to attend a trial, hearing, or deposition only as follows:

- (A) within 100 miles of where the person resides, is employed, or regularly transacts business in person; or
- (B) within the state where the person resides, is employed, or regularly transacts business in person, if the person
 - (i) is a party or a party's officer; or
 - (ii) is commanded to attend a trial and would not incur substantial expense.

(2) For Other Discovery. A subpoena may command:

- (A) production of documents, electronically stored information, or tangible things at a place within 100 miles of where the person resides, is employed, or regularly transacts business in person; and
- (B) inspection of premises at the premises to be inspected.

(d) Protecting a Person Subject to a Subpoena; Enforcement.

(1) Avoiding Undue Burden or Expense; Sanctions. A party or attorney responsible for issuing and serving a subpoena must take reasonable steps to avoid imposing undue burden or expense on a person subject to the subpoena. The court for the district where compliance is required must enforce this duty and impose an appropriate sanction—which may include lost earnings and reasonable attorney's fees—on a party or attorney who fails to comply.

(2) Command to Produce Materials or Permit Inspection.

(A) *Appearance Not Required.* A person commanded to produce documents, electronically stored information, or tangible things, or to permit the inspection of premises, need not appear in person at the place of production or inspection unless also commanded to appear for a deposition, hearing, or trial.

(B) *Objections.* A person commanded to produce documents or tangible things or to permit inspection may serve on the party or attorney designated in the subpoena a written objection to inspecting, copying, testing, or sampling any or all of the materials or to inspecting the premises—or to producing electronically stored information in the form or forms requested. The objection must be served before the earlier of the time specified for compliance or 14 days after the subpoena is served. If an objection is made, the following rules apply:

- (i) At any time, on notice to the commanded person, the serving party may move the court for the district where compliance is required for an order compelling production or inspection.
- (ii) These acts may be required only as directed in the order, and the order must protect a person who is neither a party nor a party's officer from significant expense resulting from compliance.

(3) Quashing or Modifying a Subpoena.

(A) *When Required.* On timely motion, the court for the district where compliance is required must quash or modify a subpoena that:

- (i) fails to allow a reasonable time to comply;
- (ii) requires a person to comply beyond the geographical limits specified in Rule 45(c);
- (iii) requires disclosure of privileged or other protected matter, if no exception or waiver applies; or
- (iv) subjects a person to undue burden.

(B) *When Permitted.* To protect a person subject to or affected by a subpoena, the court for the district where compliance is required may, on motion, quash or modify the subpoena if it requires:

- (i) disclosing a trade secret or other confidential research, development, or commercial information; or

(ii) disclosing an unretained expert's opinion or information that does not describe specific occurrences in dispute and results from the expert's study that was not requested by a party.

(C) *Specifying Conditions as an Alternative.* In the circumstances described in Rule 45(d)(3)(B), the court may, instead of quashing or modifying a subpoena, order appearance or production under specified conditions if the serving party:

- (i) shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship; and
- (ii) ensures that the subpoenaed person will be reasonably compensated.

(e) Duties in Responding to a Subpoena.

(1) Producing Documents or Electronically Stored Information. These procedures apply to producing documents or electronically stored information:

(A) *Documents.* A person responding to a subpoena to produce documents must produce them as they are kept in the ordinary course of business or must organize and label them to correspond to the categories in the demand.

(B) *Form for Producing Electronically Stored Information Not Specified.* If a subpoena does not specify a form for producing electronically stored information, the person responding must produce it in a form or forms in which it is ordinarily maintained or in a reasonably usable form or forms.

(C) *Electronically Stored Information Produced in Only One Form.* The person responding need not produce the same electronically stored information in more than one form.

(D) *Inaccessible Electronically Stored Information.* The person responding need not provide discovery of electronically stored information from sources that the person identifies as not reasonably accessible because of undue burden or cost. On motion to compel discovery or for a protective order, the person responding must show that the information is not reasonably accessible because of undue burden or cost. If that showing is made, the court may nonetheless order discovery from such sources if the requesting party shows good cause, considering the limitations of Rule 26(b)(2)(C). The court may specify conditions for the discovery.

(2) Claiming Privilege or Protection.

(A) *Information Withheld.* A person withholding subpoenaed information under a claim that it is privileged or subject to protection as trial-preparation material must:

- (i) expressly make the claim; and
- (ii) describe the nature of the withheld documents, communications, or tangible things in a manner that, without revealing information itself privileged or protected, will enable the parties to assess the claim.

(B) *Information Produced.* If information produced in response to a subpoena is subject to a claim of privilege or of protection as trial-preparation material, the person making the claim may notify any party that received the information of the claim and the basis for it. After being notified, a party must promptly return, sequester, or destroy the specified information and any copies it has; must not use or disclose the information until the claim is resolved; must take reasonable steps to retrieve the information if the party disclosed it before being notified; and may promptly present the information under seal to the court for the district where compliance is required for a determination of the claim. The person who produced the information must preserve the information until the claim is resolved.

(g) Contempt.

The court for the district where compliance is required—and also, after a motion is transferred, the issuing court—may hold in contempt a person who, having been served, fails without adequate excuse to obey the subpoena or an order related to it.

ATTACHMENT B

DEFINITIONS

1. The terms “Plaintiff” and “Canon” refer to Canon Inc.
2. The terms “Defendants” and “TCL” include TCL Electronics Holdings Ltd. (formerly known as TCL Multimedia Technology Holdings, Ltd.), TCL Corporation (“TCL Corp.”), Shenzhen TCL New Technologies Co. Ltd., TCL King Electrical Appliances (Huizhou) Co., Ltd., TCL King Electronics (Chengdu) Co., Ltd., TCL King Electrical Appliances (Nanchang) Co., Ltd., TCL Tongli Electronics (Huizhou) Co., Ltd. and Tonly Electronics Holdings Ltd., and include any subsidiaries, affiliates, divisions, successors, or assignees, and their respective officers, directors, employees, consultants, contractors, representatives, and agents.
3. The terms “Roku,” “You,” and “Your” refer to Roku, Inc., and include any subsidiaries, affiliates, divisions, successors, or assignees, and their respective officers, directors, employees, consultants, contractors, representatives, and agents.
4. The term “Asserted Patents” refers collectively to the following patents: U.S. Patent Nos. 7,746,413 (“413 Patent”), 8,078,767 (“767 Patent”), 8,346,986 (“986 Patent”), 8,713,206 (“206 Patent”), and 7,810,130 (“130 Patent”). It also includes the application from which each was issued, its entire prosecution history, any reexamination certificate, and all foreign counterparts, including foreign applications and foreign prosecution histories.
5. The term “Roku OS” refers to all versions of operating systems and applications developed by and/or provided by Roku and resident on TVs.
6. The term “TCL Roku TVs” refers to TVs manufactured by TCL that use Roku OS.
7. The term “Accused Products” refers to TCL Roku TVs, including:

- 3-series TV systems (e.g., 32S301; 40S303, 43S303, 49S303; 28S305, 32S305, 40S305, 43S305, 49S305; 32S321; 32S325, 40S325, 43S325, 49S325; 32S327);
- 4-series TV systems (e.g., 55S401, 65S401; 43S403, 49S403, 55S403, 65S403; 43S405, 49S405, 55S405, 65S405; 43S421, 50S421, 55S421, 65S421; 43S423, 50S423, 55S423, 65S423, 75S423; 43S425, 49S425, 50S425, 55S425, 65S425, 75S425);
- 5-series TV systems (e.g., 43S515, 49S515, 55S515, 65S515; 43S517, 49S517, 55S517, 65S517; 43S525, 50S525, 55S525, 65S525);
- 6-series TV systems (e.g., 55R615, 65R615, 75R615; 55R617, 65R617, 75R617; 55R625, 65R625);
- P6-series TV systems (e.g., 55P605; 55P607);
- C8-series TV systems (e.g., 55C803, 75C803; 55C807, 65C807, 75C807);
- S-series TV systems (e.g., 55US57; 55US5800, 65US5800; 32S3700, 48FS3700, 55FS3700; 28S3750, 32S3750, 40FS3750, 48FS3750, 55FS3750; 32S3800, 40FS3800, 50FS3800; 32S3850A, 32S3850B, 32S3850P, 32S3850, 40FS3850, 50FS3850, 55FS3850; 32FS4610R, 40FS4610R, 48FS4610R, 55FS4610R);
- P-series TV systems (e.g., 43FP110, 49FP110; 43UP120, 50UP120, 55UP120; 43UP130, 50UP130, 55UP130); and
- 8-series TV systems (e.g., 65Q825, 75Q825).

8. The term “TCL Roku TV Remote Controls” refers to remote controls manufactured or provided by You or TCL that are used to operate TCL Roku TVs.

9. The term “Roku iOS App” refers to a program used on an Apple smart phone or tablet that is designed to be used with TVs using the Roku OS, including the Accused Products.

10. The term “Roku Android App” refers to a program used on an Android-based smart phone or tablet that is designed to be used with TVs using the Roku OS, including the Accused Products.

11. The term “Wired Connection” includes, among others, connections made using

Ethernet cable, USB, or HDMI.

12. The term “Wireless Connection” includes, among others, wireless connections made using Wi-Fi or Bluetooth.

13. The term “Remote Control Device” includes, among others, TCL Roku TV Remote Controls, platforms with Roku iOS App or Roku Android App.

14. The term “schematics” includes schematic diagrams, flowcharts, models, drawings, graphic representations and other engineering documentation describing or relating to a product.

15. The term “source code” includes all files used to compile and link any executable image that is programmed in to, or used to create, any integrated circuits that are installed on to the printed circuit boards of the Accused Products or on to the printed circuit boards of the TCL Roku TV Remote Controls. Source code includes high level software language source files (e.g., .c and .cpp files), high level hardware language source files (e.g., .v, .vs and .vhd files), header files (e.g., .h and .hpp files), assembly language files (e.g., .asm files), resource files (e.g. .res files), makefiles, linker files, build scripts, and batch or command files.

16. The term “application code” includes all files used to compile and link any application intended to be used on a smart phone or tablet. Application code includes high level software language source files (e.g. .m and .java files), header files (e.g. .h and .hpp files), resource files (e.g. .res files), makefiles, linker files, build scripts, and batch or command files.

17. The term “document” is used in the broadest sense permitted by the Federal Rules of Civil Procedure and means the original (or any copy when originals are not available) and any drafts or non-identical copies thereof, whether different from the original because of interlineations, receipt stamp, notion of copy sent or received or otherwise, of any email, instant message, voicemail, book, pamphlet, periodical, letter, report, note, memorandum, record,

minutes, calendar or diary entry, transcript, study, compilation, analysis, tabulation, map, diagram, drawing, plan, picture, summary, working paper, chart, paper, graph index, data sheet, data processing card, computer printout, summary of a computer printout, tape, contract, agreement, lease, ledger, journal, balance sheet, account, invoice, purchase order, receipt, billing record, financial data, financial statement, file, diary, film, trip tickets, telex, teletype or other messages, telegram, expense vouchers, instructions, bulletins, or any other writing or recording of information, as well as all tape recordings, computer tapes, discs, and other electronic or mechanical recordings, however produced, maintained or reproduced, including information stored in or generated by a computer whether or not ever printed out or displayed, within Your possession, custody, or control.

18. The term “person” means any natural person, corporation, firm, company, sole proprietorship, partnership, joint venture, association, institute, or other business, legal, or governmental entity or association, including any directors, officers, employees, agents, or representatives thereof.

19. The term “agreement” means a contract, agreement, arrangement or understanding, formal or informal, oral or written, between two or more persons.

20. The term “communication” refers to any transfer of information, oral or written, be it in the form of facts, ideas, inquiries, opinions, or otherwise, by any means, at any time or place, under any circumstances, and is not limited to transfers between persons, but includes other transfers, such as records and memoranda to the file.

21. The terms “sale,” “sales,” “sell” or “sold” include sales, licenses, leases, loans, consignments, distribution to resellers or others and all other methods of product distribution whether direct or indirect, and whether the product is distributed singly or in combination with or as part of another product, and whether or not revenue was or will be

received therefrom.

22. The term “any” should be understood in either its most or least inclusive sense as will bring within the scope of the topic all responses that might otherwise be construed to be out of its scope.

23. The term “including” shall mean including but not limited to.

24. The terms “relate,” “relating,” or “relates” mean in any way, directly or indirectly, in whole or part, relating to, concerning, referring to, discussing, mentioning, regarding, pertaining to, describing, reflecting, containing, analyzing, studying, reporting on, commenting on, evidencing, constituting, setting forth, considering, recommending, modifying, amending, confirming, endorsing, representing, supporting, qualifying, terminating, revoking, refuting, undermining, canceling, contradicting, or negating.

25. The terms “and” and “or” shall be construed disjunctively or conjunctively as necessary to bring within the scope of these topics all information which might otherwise be construed to be outside their scope.

26. “Each” and “every” mean “each and every.”

27. The term “identify,” when used in conjunction with a person, means to provide, to the extent known, the person’s full name, present or last known address, and telephone number, country of residence, and country of citizenship; and when referring to a natural person, additionally, the present or last known place of employment and, when referring to a current or former director, officer, manager or other employee, additionally the title(s) or position(s) held by such person, the time periods during which such person held such position(s), and a description of the responsibilities of such person to those position(s).

28. The term “identify,” when used with respect to any entity, such as a corporation, company, or person other than a natural person, means that the following information shall be

provided: the entity's name; the principal place of business; and the nature of the business conducted by that entity.

29. The term "identify," when used in conjunction with a document or other thing, means to specify the document or thing in sufficient detail to permit Canon to locate the document or thing.

30. The term "Action" means the civil action titled *Canon Inc. v. TCL Elecs. Holdings Ltd., et al.*, Civil Action No. 2:18-cv-00546 (E.D. Tex.).

31. The use of the word "the" shall not be construed as limiting the scope of any request.

REQUESTS FOR PRODUCTION

1. All agreements, including but not limited to, any licenses and renewals, between You and TCL relating to any TCL Roku TVs, TCL Roku TV Remote Controls, Roku iOS App, Roku Android App, or Remote Control Device, including, but not limited to, any documents and communications exchanged between You and TCL concerning any agreement between You and TCL relating to any Accused Products.
2. All documents relating to Your licensing Roku OS, Roku iOS App, or Roku Android App, or any other software to TCL.
3. All documents and communications related to Your activities and interactions with TCL as it relates to any Accused Products.
4. All documents related to the following statement on page 7 of Your 2019 10-K Annual Report (<https://ir.roku.com/static-files/195156b3-38a1-4c31-8656-b968101924ba>) as related to TCL and/or TCL Roku TVs: “Roku TVs integrate our Roku Operating System, or Roku OS, and leverage our smart TV hardware reference design. We work with our TV brand licensees to assist in all phases of the development of Roku TVs, including development, planning, manufacturing and marketing.”
5. Documents sufficient to show the process of integrating Roku OS with TCL Roku TVs, the Roku iOS App and the Roku Android App.
6. Documents sufficient to show the testing and quality assurance processes of TCL Roku TVs.
7. Documents sufficient to describe how You ensure interoperability of the hardware for the TCL Roku TVs with “all channels and other offerings, technologies and systems from our content publishers, including virtual multi-channel video programming distributors such as Sling TV” as described in the page 14 of Your 2019 10-K Annual Report (<https://ir.roku.com/static->

files/195156b3-38a1-4c31-8656-b968101924ba).

8. All documents concerning the structure, architecture, and/or design of TCL Roku TV hardware, Roku OS, Roku iOS App or Roku Android App in Your possession, custody or control. Such documents include, but are not limited to:

- (a) Your communications with TCL concerning TCL Roku TV hardware, Roku OS, Roku iOS App or Roku Android App;
- (b) Product and technical specifications related to (a), above;
- (c) Schematics relating to (a), above;¹
- (d) User manuals, instruction manuals, and training documents relating to (a), above;
- (e) Testing documents relating to (a), above; and
- (f) Operation manuals and documents relating to (a), above.

9. All documents concerning the structure, architecture, function and/or operation of TCL Roku TV Remote Controls as used with the Accused Products. Such documents include, but are not limited to:

- (a) Your communications with TCL concerning TCL Roku TV Remote Control;
- (b) Product and technical specifications relating to (a), above;
- (c) Schematics relating to (a), above;²
- (d) User manuals, instruction manuals, and training documents relating to (a), above;
- (e) Testing documents relating to (a), above; and
- (f) Operation manuals and documents relating to (a), above.

¹ Schematics should be produced both natively (i.e., in the format of the CAD package used to capture the design) and as PDF printouts (in color and printed at the highest possible resolution; scans of printed copies are unacceptable).

² Schematics should be produced both natively (i.e., in the format of the CAD package used to capture the design) and as PDF printouts (in color and printed at the highest possible resolution; scans of printed copies are unacceptable).

10. All documents concerning the structure, architecture, function and/or operation of Roku iOS App as used with TVs using the Roku OS, including the Accused Products. Such documents include, but are not limited to:

- (a) Your communications with TCL concerning Roku iOS App;
- (b) Product and technical specifications relating to (a), above;
- (c) Schematics relating to (a), above;³
- (d) Application code for the iOS App relating to (a), above;
- (e) User manuals, instruction manuals, and training documents relating to (a), above;
- (f) Testing documents relating to (a), above; and
- (g) Operation manuals and documents relating to (a), above.

11. All documents concerning the structure, architecture, function and/or operation of Roku Android App as used with TVs using the Roku OS, including the Accused Products. Such documents include, but are not limited to:

- (a) Your communications to and from TCL concerning Roku Android App;
- (b) Product and technical specifications relating to (a), above;
- (c) Schematics relating to (a), above;⁴
- (d) Application code for the Android App;
- (e) User manuals, instruction manuals, and training documents relating to (a), above;
- (f) Testing documents relating to (a), above; and
- (g) Operation documents relating to (a), above.

³ Schematics should be produced both natively (i.e., in the format of the CAD package used to capture the design) and as PDF printouts (in color and printed at the highest possible resolution; scans of printed copies are unacceptable).

⁴ Schematics should be produced both natively (i.e., in the format of the CAD package used to capture the design) and as PDF printouts (in color and printed at the highest possible resolution; scans of printed copies are unacceptable).

12. Documents sufficient to show and explain the following features of Roku

OS:

- (a) Receiving streaming content;
- (b) Playing streaming content;
- (c) Accessing a URL of streaming content;
- (d) Buffering streaming content;
- (e) Receiving and processing instructions from remote controls;
- (f) Communicating with external devices, including USB drives, devices connected using HDMI, devices using Roku iOS App, and devices using Roku Android App; and
- (g) Displaying different graphical user interface depending on the remote control being used.

13. Source code relevant to the following features of Roku OS:

- (a) Receiving streaming content;
- (b) Playing streaming content;
- (c) Accessing a URL of streaming content;
- (d) Buffering streaming content;
- (e) Receiving and processing instructions from remote controls;
- (f) Communicating with external devices, including USB drives, devices connected using HDMI, devices using Roku iOS App, and devices using Roku Android App; and
- (g) Displaying different graphical user interface depending on the remote control being used.

14. Documents sufficient to show the quarterly revenue of any collateral or conveyed products or services sold in the United States involving the use of an Accused Product between 2014 and present, including but not limited to:

- (a) Total revenues (gross and net revenues);
- (b) Revenues from licensing Roku platform to TCL;

- (c) Number of active accounts using Accused TVs;
- (d) Revenues derived from video advertisement played on Accused TVs;
- (e) Revenues derived from subscriptions of streaming content on Accused TVs;
- (f) Number of streamed hours on Accused TVs;
- (g) Number of units sold;
- (h) Gross margin;
- (i) Operating costs;
- (j) Operating margin;
- (k) Net margin; and
- (l) Net profits.

15. Documents sufficient to show how Roku's custom advertising framework, RAF, operates and when contents developers are required to integrate this RAF for fulfilling and rendering video advertisements.

16. All documents relating to the benefits (monetary and non-monetary) You received (or expected to receive) from the Accused Products being sold and used in the United States, including, but not limited to, projected, expected, or actual impact that the Accused Products had on Your sales of other products or services. To the extent possible, the information identified in this request should be broken down by model of the Accused Products.

17. All documents and communications exchanged between You and TCL concerning Canon, any Accused Products, the TCL Roku TV Remote Controls, the Roku iOS App, the Roku Android App or the Asserted Patents.

18. All documents and communications related to any discussions, requests, offers, or agreements related to indemnification between You and TCL.

19. All agreements between You and others concerning TCL Roku TVs, including

channel developers, content publishers, and CDN providers.

20. All documents relating to the indemnification (or offers or requests to indemnify) by or of You as relates to the Asserted Patents and/or this litigation.

21. All communications between You and TCL related to any litigation between Canon and TCL and/or relating to this subpoena.

22. All deposition transcripts of Your witnesses deposed in *MV3 Partners LLC v. Roku, Inc.*, Case No. 6:18-cv-308 between March 26, 2019 and April 8, 2019 under the court order dated March 26, 2019 allowing MV3 Partners, LLC “to take the deposition of a corporate representative of [Roku] to establish which employees will be relevant to [said] patent litigation and their geographic location,” including all exhibits to the transcripts.

23. All documents and communications sufficient to show following employees’ involvement in the Accused Products or any TCL Roku TVs, including their communications with TCL:

- (i) Anna Shevelieva (QA Engineer)
- (ii) Arnold Dobson (Sr. QA Engineer)
- (iii) Frank Harris (Sr. Program Manager, New Products Software)
- (iv) Joel East (Sr. Hardware Design Engineer)
- (v) Joshua Fontenot (QA Engineer)
- (vi) Feiyang Xue (Embedded Software Engineer)
- (vii) Ken Krakow (Director, Hardware Engineering)
- (viii) Ken Smeltzer (Firmware Engineer)
- (ix) Konstantin S. (Sr. Software Development Engineer)
- (x) Linmei Shu (Director, Software Engineering)
- (xi) Lloyd R. (QAS Alpha Beta Coordinator)
- (xii) Marcus Grande (Sr. Software Engineer)
- (xiii) Mark Thissen (Sr. QA Engineer)
- (xiv) Matt Korte (Sr. Manager, Software Development)
- (xv) Matthew Hodgins (Sr. Lead Software Engineer, Test)

- (xvi) Michael Zhang (Sr. Software Engineer)
- (xvii) Nermin Osmanovic (Sr. QA Engineer)
- (xviii) Scott de Haas (SVP Product Engineering and Operations)
- (xix) Sergejs Kovrovs (Sr. Software Engineer)
- (xx) Tim Wegesin (Sr. Hardware Engineer, New Products)

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**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION**

CANON, INC.

v.

TCL ELECTRONICS HOLDINGS LTD., et
al.

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§
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Case No. 2:18-CV-546-JRG

PROTECTIVE ORDER

WHEREAS, Plaintiff Canon, Inc. (“Canon” or “Plaintiff”), and Defendants TCL Electronics Holdings Ltd. (formerly known as TCL Multimedia Technology Holdings, Ltd.), TCL Corporation (“TCL Corp.”), Shenzhen TCL New Technologies Co. Ltd., TCL King Electrical Appliances (Huizhou) Co., Ltd., TCL King Electronics (Chengdu) Co., Ltd., TCL King Electrical Appliances (Nanchang) Co., Ltd., TCL Tongli Electronics (Huizhou) Co., Ltd. and Tonly Electronics Holdings Ltd. (collectively, “TCL” or “Defendants”), hereafter referred to collectively as “the Parties,” believe that certain information that is or will be encompassed by discovery demands by the Parties involves the production or disclosure of trade secrets, confidential business information, or other proprietary information;

WHEREAS, the Parties seek a protective order limiting disclosure thereof in accordance with Federal Rule of Civil Procedure 26(c):

THEREFORE, it is hereby stipulated among the Parties and ORDERED that:

1. Each Party may designate as confidential for protection under this Order, in whole or in part, any document, information or material that constitutes or includes, in whole or in part, confidential or proprietary information or trade secrets of the Party or a Third Party to whom

- the Party reasonably believes it owes an obligation of confidentiality with respect to such document, information or material ("Protected Material"). Protected Material shall be designated by the Party producing it by affixing a legend or stamp on such document, information or material as follows: "CONFIDENTIAL," "RESTRICTED - ATTORNEYS' EYES ONLY," or "RESTRICTED CONFIDENTIAL SOURCE CODE." The word(s) "CONFIDENTIAL," "RESTRICTED - ATTORNEYS' EYES ONLY," or "RESTRICTED CONFIDENTIAL SOURCE CODE" shall be placed clearly on each page of the Protected Material (except deposition and hearing transcripts) for which such protection is sought. For deposition and hearing transcripts, the word(s) "CONFIDENTIAL," "RESTRICTED - ATTORNEYS' EYES ONLY," or "RESTRICTED CONFIDENTIAL SOURCE CODE" shall be placed on the cover page of the transcript (if not already present on the cover page of the transcript when received from the court reporter) by each attorney receiving a copy of the transcript after that attorney receives notice of the designation of some or all of that transcript as "CONFIDENTIAL."
2. Any document produced under Patent Rules 2-2, 3-2, and/or 3-4 before issuance of this Order with the designation "Confidential" or "Confidential - Outside Attorneys' Eyes Only" shall receive the same treatment as if designated "RESTRICTED - ATTORNEYS' EYES ONLY" under this Order, unless and until such document is redesignated to have a different classification under this Order.
3. With respect to documents, information or material designated "CONFIDENTIAL," "RESTRICTED - ATTORNEYS' EYES ONLY," or "RESTRICTED CONFIDENTIAL

SOURCE CODE” (“DESIGNATED MATERIAL”),¹ subject to the provisions herein and unless otherwise stated, this Order governs, without limitation: (a) all documents, electronically stored information, and/or things as defined by the Federal Rules of Civil Procedure; (b) all pretrial, hearing or deposition testimony, or documents marked as exhibits or for identification in depositions and hearings; (c) pretrial pleadings, exhibits to pleadings and other court filings; (d) affidavits; and (e) stipulations. All copies, reproductions, extracts, digests and complete or partial summaries prepared from any DESIGNATED MATERIALS shall also be considered DESIGNATED MATERIAL and treated as such under this Order.

4. A designation of Protected Material (i.e., “CONFIDENTIAL,” “RESTRICTED - ATTORNEYS’ EYES ONLY,” or “RESTRICTED CONFIDENTIAL SOURCE CODE”) may be made at any time. Inadvertent or unintentional production of documents, information or material that has not been designated as DESIGNATED MATERIAL shall not be deemed a waiver in whole or in part of a claim for confidential treatment. Any party that inadvertently or unintentionally produces Protected Material without designating it as DESIGNATED MATERIAL may request destruction of that Protected Material by notifying the recipient(s), as soon as reasonably possible after the producing Party becomes aware of the inadvertent or unintentional disclosure, and providing replacement Protected Material that is properly designated. The recipient(s) shall destroy all copies of the inadvertently or unintentionally produced Protected Materials and any documents, information or material

¹ The term DESIGNATED MATERIAL is used throughout this Protective Order to refer to the class of materials designated as “CONFIDENTIAL,” “RESTRICTED - ATTORNEYS’ EYES ONLY,” or “RESTRICTED CONFIDENTIAL SOURCE CODE,” both individually and collectively.

derived from or based thereon as soon as the recipient(s) receives notices by the designating party of the inadvertent or unintentional production.

5. “CONFIDENTIAL” documents, information and material may be disclosed only to the following persons, except upon receipt of the prior written consent of the designating party, upon order of the Court, or as set forth in paragraph 12 herein:

- (a) outside counsel of record in this Action for the Parties;
- (b) employees of such counsel assigned to and reasonably necessary to assist such counsel in the litigation of this Action;
- (c) in-house counsel for the Parties who either have responsibility for making decisions dealing directly with the litigation of this Action, or who are assisting outside counsel in the litigation of this Action;
- (d) up to and including three (3) designated representatives of each of the Parties to the extent reasonably necessary for the litigation of this Action, except that either party may in good faith request the other party’s consent to designate one or more additional representatives, the other party shall not unreasonably withhold such consent, and the requesting party may seek leave of Court to designate such additional representative(s) if the requesting party believes the other party has unreasonably withheld such consent;
- (e) outside consultants or experts (*i.e.*, not existing employees or affiliates of a Party or an affiliate of a Party) retained for the purpose of this litigation, provided that: (1) such consultants or experts are not presently employed by the Parties hereto for purposes other than this Action; (2) before access is given, the consultant or expert has completed the Undertaking attached as Exhibit A hereto and the same is served upon the producing Party with a current curriculum vitae of the consultant or expert, which identifies the expert’s current employer(s), and the name and case number where the expert has offered expert testimony, including by declaration, report, or testimony at deposition or trial, in the past five years, at least ten (10) business days before access to the Protected Material is to be given to that consultant or Undertaking to object to and notify the receiving Party in writing that it objects to disclosure of Protected Material to the consultant or expert. The Parties agree to promptly confer and use good faith to resolve any such objection. If the Parties are unable to resolve any objection, the objecting Party may file a motion with the Court within fifteen (15) days of the notice, or within such other time as the Parties may agree, seeking a protective order with respect to the proposed disclosure. The objecting Party shall have the burden of proving the need for a protective order. No disclosure shall occur until all such objections are resolved by agreement or Court order;

- (f) independent litigation support services, including persons working for or as court reporters, graphics or design services, jury or trial consulting services, and photocopy, document imaging, and database services retained by counsel and reasonably necessary to assist counsel with the litigation of this Action; and
 - (g) the Court and its personnel.
- 6. A Party shall designate documents, information or material as “CONFIDENTIAL” only upon a good faith belief that the documents, information or material contains confidential or proprietary information or trade secrets of the Party or a Third Party to whom the Party reasonably believes it owes an obligation of confidentiality with respect to such documents, information or material.
- 7. Documents, information or material produced pursuant to any discovery request in this Action, including but not limited to Protected Material designated as DESIGNATED MATERIAL, shall be used by the Parties only in the litigation of this Action and shall not be used for any other purpose. Any person or entity who obtains access to DESIGNATED MATERIAL or the contents thereof pursuant to this Order shall not make any copies, duplicates, extracts, summaries or descriptions of such DESIGNATED MATERIAL or any portion thereof except as may be reasonably necessary in the litigation of this Action. Any such copies, duplicates, extracts, summaries or descriptions shall be classified DESIGNATED MATERIALS and subject to all of the terms and conditions of this Order.
- 8. To the extent a producing Party believes that certain Protected Material qualifying to be designated CONFIDENTIAL is so sensitive that its dissemination deserves even further limitation, the producing Party may designate such Protected Material “RESTRICTED – ATTORNEYS’ EYES ONLY,” or to the extent such Protected Material includes computer source code and/or live data (that is, data as it exists residing in a database or databases)

(“Source Code Material”), the producing Party may designate such Protected Material as “RESTRICTED CONFIDENTIAL SOURCE CODE.”

9. For Protected Material designated “RESTRICTED – ATTORNEYS’ EYES ONLY,” access to, and disclosure of, such Protected Material shall be limited to individuals listed in paragraphs 5(a), (b), and (e-g).
10. For Protected Material designated “RESTRICTED CONFIDENTIAL SOURCE CODE,” the following additional restrictions apply:

- (a) Access to a Party’s Source Code Material shall be provided only on “stand-alone” computer(s) (that is, the computer may not be linked to any network, including a local area network (“LAN”), an intranet or the Internet), with sufficient technical specifications for viewing the Source Code Material that the Parties discuss in good faith and agree upon prior to the inspection. The stand-alone computer(s) may be connected to (i) a printer, or (ii) a device capable of temporarily storing electronic copies solely for the limited purposes permitted pursuant to paragraphs 10 (h and k) below. Additionally, except as provided in paragraphs 10 (j and k) below, the stand-alone computer(s) may only be located at the offices of the producing Party’s outside counsel. Prior to the first inspection of any requested Source Code Material, the receiving Party shall provide ten (10) business days’ notice of the Source Code Material that it wishes to inspect. The receiving Party shall provide three (3) business days’ notice prior to any additional inspections. The receiving Party shall make good faith efforts to reasonably accommodate scheduling limitations identified by the producing Party. When requesting inspection of a Party’s Source Code Material, the receiving Party shall identify all persons who will inspect the producing Party’s Source Code Material on behalf of a receiving Party, including members of a receiving Party’s outside law firm;
- (b) The receiving Party shall make reasonable efforts to restrict its requests for such access to the stand-alone computer(s) to normal business hours, which for purposes of this paragraph shall be 9:00 a.m. through 6:00 p.m. on normal business days (*i.e.*, weekdays that are not federal in the United States or state holidays in state of inspection of the Source Code Material). However, upon reasonable notice from the receiving party, the producing Party shall make reasonable efforts to accommodate the receiving Party’s request for access to the stand-alone computer(s) outside of normal business hours. The Parties agree to cooperate in good faith such that maintaining the producing Party’s Source Code Material at the offices of its outside counsel shall not unreasonably hinder the receiving Party’s ability to efficiently and effectively conduct the prosecution or defense of this Action;

- (c) The producing Party shall provide the receiving Party with information explaining how to start, log on to, and operate the stand-alone computer(s) in order to access the produced Source Code Material on the stand-alone computer(s). The producing Party may visually monitor, but only from outside the room in which the stand-alone computer(s) is located, the activities of the receiving Party's representatives during any Source Code Material review, but only to ensure that no unauthorized electronic records of the Source Code Material and no electronic information concerning the Source Code Material are being created or transmitted in any way;
- (d) The producing Party will produce Source Code Material in its native form and native directory structure on the stand-alone computer(s) as described above;
- (e) Access to Protected Material designated "RESTRICTED CONFIDENTIAL - SOURCE CODE" shall be limited to outside counsel and up to three (3) outside consultants or experts² (*i.e.*, not existing employees or affiliates of a Party or an affiliate of a Party) retained for the purpose of this litigation and approved to access such Protected Materials pursuant to paragraph 5(e) above. A receiving Party may include excerpts of Source Code Material in a pleading, exhibit, expert report, discovery document, deposition transcript, other Court document, provided that the Source Code Documents are appropriately marked under this Order, restricted to those who are entitled to have access to them as specified herein, and, if filed with the Court, filed under seal in accordance with the Court's rules, procedures and orders;
- (f) To the extent portions of Source Code Material are quoted in a Source Code Document, either (1) the entire Source Code Document will be stamped and treated as "RESTRICTED CONFIDENTIAL SOURCE CODE" or (2) those pages containing quoted Source Code Material will be separately stamped and treated as "RESTRICTED CONFIDENTIAL SOURCE CODE";
- (g) Except as set forth in paragraph 10(k) below, no electronic copies of Source Code Material shall be made without prior written consent of the producing Party, except as necessary to create documents which, pursuant to the Court's rules, procedures and order, must be filed or served electronically;
- (h) Except as provided in this Order, no physical copies of all or any portion of the Source Code Material may leave the source code review room. The receiving Party may request up to four (4) printouts of limited portions of source code (on 8.5 by 11 inch paper, in no smaller than 12 point font, with at least 1 inch margins on all sides) that are reasonably necessary for the preparation of court filings, pleadings,

² For the purposes of this paragraph, an outside consultant or expert is defined to include the outside consultant's or expert's direct reports and other support personnel, such that the disclosure to a consultant or expert who employs others within his or her firm to help in his or her analysis shall count as a disclosure to a single consultant or expert.

expert reports, or other papers, or for deposition or trial, but shall not request paper copies for the purpose of reviewing the source code other than electronically. The receiving Party shall not be permitted to make photocopies of Source Code Material absent express written permission from the producing Party. The receiving Party may request up to 250 pages total of code per software product. If the receiving Party requests more than 20 (twenty) pages of a continuous block of code, the producing Party may object to the production of pages in excess of this limit. Within five (5) business days of the receiving Party's request, the producing Party shall either: (i) provide all such source code in paper form including with production numbers and the label "RESTRICTED CONFIDENTIAL SOURCE CODE." or (ii) inform the Receiving Party that it objects that the printed portions are excessive. If, after meeting and conferring, the Producing Party and the receiving Party cannot resolve the objection, the Producing Party shall be entitled to seek a Court resolution establishing why it should not comply with the request. The printed pages of source code in question need not be produced to the receiving Party until the objection is resolved by the Court. The printed pages shall constitute part of the source code produced by the producing Party in this action;

- (i) Should such printouts or photocopies be transferred back to electronic media, such media shall be labeled "RESTRICTED CONFIDENTIAL SOURCE CODE" and shall continue to be treated as such;
- (j) If the receiving Party's outside counsel, consultants, or experts obtain printouts or photocopies of Source Code Material, the receiving Party shall ensure that such outside counsel, consultants, or experts keep the printouts or photocopies in a secured locked area in the offices of such outside counsel, consultants, or expert. The receiving Party may also temporarily keep the printouts or photocopies at: (i) the Court for any proceedings(s) relating to the Source Code Material, for the dates associated with the proceeding(s); (ii) the sites where any deposition(s) relating to the Source Code Material are taken, for the dates associated with the deposition(s); and (iii) any intermediate location reasonably necessary to transport the printouts or photocopies (*e.g.*, a hotel prior to a Court proceeding or deposition). For depositions and court proceedings, outside counsel for the receiving Party may bring one printed copy of Source Code Material and may request to have the producing Party make available Source Code Material on the stand-alone computer(s) for use at the depositions and court proceedings. If a receiving Party intends to use Source Code Material to examine a deposition witness or during a court proceeding, the receiving Party must notify the other producing Party of that intention no later than three (3) business days prior to the deposition or court proceeding; and
- (k) A producing Party's Source Code Material may only be transported by the receiving Party at the direction of a person authorized under paragraph 10(e) above to another person authorized under paragraph 10(e) above, on paper via hand carry, Federal Express or other similarly reliable courier. Source Code Material may not be transported or transmitted electronically over a network of any kind, including a

LAN, an intranet, or the Internet, or on any removable electronic media (*e.g.*, a DVD, CD-ROM, or flash memory “stick”). Source Code Material may only be transported electronically for the purpose of Court proceeding(s) or deposition(s) as set forth in paragraph 10(j) above and is at all times subject to the transport restrictions set forth herein. But, for those purposes only, the Source Code Materials may be loaded onto a stand-alone computer.

11. Any attorney representing Plaintiff, whether in-house or outside counsel, and any person associated with Plaintiff and permitted to receive Defendants’ Protected Material that is designated “RESTRICTED – ATTORNEYS’ EYES ONLY” and/or RESTRICTED CONFIDENTIAL SOURCE CODE (collectively “HIGHLY SENSITIVE MATERIAL”), who obtains, receives, has access to, or otherwise learns, in whole or in part, producing party’s HIGHLY SENSITIVE MATERIAL under this Order shall not prepare, prosecute, supervise, or assist in the preparation or prosecution of any patent application pertaining to the field of the invention of the patents-in-suit or field of the technology of the HIGHLY SENSITIVE MATERIAL on behalf of Plaintiff or its acquirer, successor, predecessor, or other affiliate during the pendency of this Action and for two years after its conclusion, including any appeals. Notwithstanding the foregoing, nothing in this Order precludes outside counsel with access to HIGHLY SENSITIVE MATERIAL from participating in *inter partes* review proceedings, re-examinations, or covered business method reviews before the PTO, provided that any attorney who reviews, in whole or in part, the contents of HIGHLY SENSITIVE MATERIAL produced by another Party may not advise, consult, or participate in the drafting of amended or substitute claims in the proceeding, and, will not use any of the Producing Party’s Protected Material in the proceeding. To ensure compliance with the purpose of this provision, Plaintiff shall create an “Ethical Wall” between those persons with access to HIGHLY SENSITIVE MATERIAL and any individuals who, on behalf of Plaintiff or its acquirer, successor, predecessor, or other

affiliate, prepare, prosecute, supervise or assist in the preparation or prosecution of any patent application pertaining to the field of invention of the patent-in-suit. This provision shall not bar entire firms, rather only the individuals who actually receive and review a Party's HIGHLY SENSITIVE MATERIAL.

12. Nothing in this Order shall require production of documents, information or other material that a Party contends is protected from disclosure by the attorney-client privilege, the work product doctrine, or other privilege, doctrine, or immunity. If documents, information or other material subject to a claim of attorney-client privilege, work product doctrine, or other privilege, doctrine, or immunity is inadvertently or unintentionally produced, such production shall in no way prejudice or otherwise constitute a waiver of, or estoppel as to, any such privilege, doctrine, or immunity. Any Party that inadvertently or unintentionally produces documents, information or other material it reasonably believes are protected under the attorney-client privilege, work product doctrine, or other privilege, doctrine, or immunity may obtain the return of such documents, information or other material by promptly notifying the recipient(s) and providing a privilege log for the inadvertently or unintentionally produced documents, information or other material. The recipient(s) shall gather and return all copies of such documents, information or other material to the producing Party, except for any pages containing privileged or otherwise protected markings by the recipient(s), which pages shall instead be destroyed and certified as such to the producing Party.
13. There shall be no disclosure of any DESIGNATED MATERIAL by any person authorized to have access thereto to any person who is not authorized for such access under this Order.

The Parties are hereby ORDERED to safeguard all such documents, information and material to protect against disclosure to any unauthorized persons or entities.

14. Nothing contained herein shall be construed to prejudice any Party's right to use any DESIGNATED MATERIAL in taking testimony at any deposition or hearing provided that the DESIGNATED MATERIAL is only disclosed to a person(s) who is: (i) eligible to have access to the DESIGNATED MATERIAL by virtue of his or her employment with the designating party, (ii) identified in the DESIGNATED MATERIAL as an author, addressee, or copy recipient of such information, (iii) although not identified as an author, addressee, or copy recipient of such DESIGNATED MATERIAL, has, in the ordinary course of business, seen such DESIGNATED MATERIAL, (iv) a current or former officer, director or employee of the producing Party or a current or former officer, director or employee of a company affiliated with the producing Party; (v) counsel for a Party, including outside counsel (subject to paragraph 9 of this Order); (vi) an independent contractor, consultant, and/or expert retained for the purpose of this litigation; (vii) court reporters and videographers; (viii) the Court; or (ix) other persons entitled hereunder to access to DESIGNATED MATERIAL. DESIGNATED MATERIAL shall not be disclosed to any other persons unless prior authorization is obtained from counsel representing the producing Party or from the Court.
15. Parties may, at the deposition or hearing or within thirty (30) days after receipt of a deposition or hearing transcript, designate the deposition or hearing transcript or any portion thereof as "CONFIDENTIAL," "RESTRICTED - ATTORNEY' EYES ONLY," or "RESTRICTED CONFIDENTIAL SOURCE CODE" pursuant to this Order. Access to the deposition or hearing transcript so designated shall be limited in accordance with the terms

of this Order. Until expiration of the 30-day period, the entire deposition or hearing transcript shall be treated as “RESTRICTED - ATTORNEY’ EYES ONLY.”

16. Any DESIGNATED MATERIAL that is filed with the Court shall be filed under seal, shall remain under seal until further order of the Court, and shall include only the portions of DESIGNATED MATERIAL necessary to that filing. The filing party shall be responsible for informing the Clerk of the Court that the filing should be sealed and for placing the legend “FILED UNDER SEAL PURSUANT TO PROTECTIVE ORDER” above the caption and conspicuously on each page of the filing. Exhibits to a filing shall conform to the labeling requirements set forth in this Order. If a pretrial pleading filed with the Court, or an exhibit thereto, discloses or relies on confidential documents, information or material, such confidential portions shall be redacted to the extent necessary and the pleading or exhibit filed publicly with the Court.
17. The Order applies to pretrial discovery. Nothing in this Order shall be deemed to prevent the Parties from introducing any DESIGNATED MATERIAL into evidence at the trial of this Action, or from using any information contained in DESIGNATED MATERIAL at the trial of this Action, subject to any pretrial order issued by this Court.
18. A Party may request in writing to the other Party that the designation given to any DESIGNATED MATERIAL be modified or withdrawn. If the designating Party does not agree to redesignation within ten (10) business days of receipt of the written request, the requesting Party may apply to the Court for relief. Upon any such application to the Court, the burden shall be on the designating Party to show why its classification is proper. Such application shall be treated procedurally as a motion to compel pursuant to Federal Rules of Civil Procedure 37, subject to the Rule’s provisions relating to sanctions. In making

such application, the requirements of the Federal Rules of Civil Procedure and the Local Rules of the Court shall be met. Pending the Court's determination of the application, the designation of the designating Party shall be maintained.

19. Each outside consultant or expert to whom DESIGNATED MATERIAL is disclosed in accordance with the terms of this Order shall be advised by counsel of the terms of this Order, shall be informed that he or she is subject to the terms and conditions of this Order, and shall sign an acknowledgment that he or she has received a copy of, has read, and has agreed to be bound by this Order. A copy of the acknowledgment form is attached as Appendix A.
20. To the extent that any discovery is taken of persons who are not Parties to this Action ("Third Parties") and in the event that such Third Parties contended the discovery sought involves trade secrets, confidential business information, or other proprietary information, then such Third Parties may agree to be bound by this Order.
21. To the extent that discovery or testimony is taken of Third Parties, the Third Parties may designate as "CONFIDENTIAL" or "RESTRICTED – ATTORNEYS' EYES ONLY" any documents, information or other material, in whole or in part, produced or given by such Third Parties. The Third Parties shall have ten (10) business days after production of such documents, information or other materials to make such a designation. Until that time period lapses or until such a designation has been made, whichever occurs sooner, all documents, information or other material so produced or given shall be treated as "CONFIDENTIAL" in accordance with this Order.
22. Within thirty (30) days of final termination of this Action, including any appeals, all DESIGNATED MATERIAL, including all copies, duplicates, abstracts, indexes, summaries,

descriptions, and excerpts or extracts thereof (excluding excerpts or extracts incorporated into any privileged memoranda of the Parties and materials which have been admitted into evidence in this Action), shall at the producing Party's election either be returned to the producing Party or be destroyed. The receiving Party shall verify the return or destruction by affidavit furnished to the producing Party, upon the producing Party's request.


23. The failure to designate documents, information or material in accordance with this Order and the failure to object to a designation at a given time shall not preclude the filing of a motion at a later date seeking to impose such designation or challenging the propriety thereof. The entry of this Order and/or the production of documents, information and material hereunder shall in no way constitute a waiver of any objection to the furnishing thereof, all such objections being hereby preserved.
24. Any Party knowing or believing that any other party is in violation of or intends to violate this Order and has raised the question of violation or potential violation with the opposing party and has been unable to resolve the matter by agreement may move the Court for such relief as may be appropriate in the circumstances. Pending disposition of the motion by the Court, the Party alleged to be in violation of or intending to violate this Order shall discontinue the performance of and/or shall not undertake the further performance of any action alleged to constitute a violation of this Order.
25. Production of DESIGNATED MATERIAL by each of the Parties shall not be deemed a publication of the documents, information and material (or the contents thereof) produced so as to void or make voidable whatever claim the Parties may have as to the proprietary and confidential nature of the documents, information or other material or its contents.

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26. Nothing in this Order shall be construed to effect an abrogation, waiver or limitation of any kind on the rights of each of the Parties to assert any applicable discovery or trial privilege.
27. Each of the Parties shall also retain the right to file a motion with the Court (a) to modify this Order to allow disclosure of DESIGNATED MATERIAL to additional persons or entities if reasonably necessary to prepare and present this Action and (b) to apply for additional protection of DESIGNATED MATERIAL.

So Ordered this

Nov 12, 2019



RODNEY GILSTRAP
UNITED STATES DISTRICT JUDGE

**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION**

CANON, INC.

v.

TCL ELECTRONICS HOLDINGS LTD., et
al.

§
§
§
§
§

Case No. 2:18-CV-546-JRG

**APPENDIX A
UNDERTAKING OF EXPERTS OR CONSULTANTS REGARDING
PROTECTIVE ORDER**

I, _____, declare that:

1. My address is _____.
My current employer is _____.
My current occupation is _____.
2. I have received a copy of the Protective Order in this action. I have carefully read and understand the provisions of the Protective Order.
3. I will comply with all of the provisions of the Protective Order. I will hold in confidence, will not disclose to anyone not qualified under the Protective Order, and will use only for purposes of this action any information designated as "CONFIDENTIAL," "RESTRICTED – ATTORNEYS' EYES ONLY," or "RESTRICTED CONFIDENTIAL SOURCE CODE" that is disclosed to me.
4. Promptly upon termination of these actions, I will return all documents and things designated as "CONFIDENTIAL," "RESTRICTED – ATTORNEYS' EYES ONLY," or "RESTRICTED CONFIDENTIAL SOURCE CODE" that came into my possession,

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and all documents and things that I have prepared relating thereto, to the outside counsel
for the party by whom I am employed.

5. I hereby submit to the jurisdiction of this Court for the purpose of enforcement of the
Protective Order in this action.

I declare under penalty of perjury that the foregoing is true and correct.

Signature _____

Date _____



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January 13, 2020

Andrew T. Radsch
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BY E-MAIL

Yar R. Chaikovsky
Paul Hastings LLP
1117 S. California Avenue
Palo Alto, California 94304-1106
yarchaikovsky@paulhastings.com

Re: Subpoena to Roku, Inc. in Connection with *Canon, Inc. v. TCL Electronics Holdings Ltd., et al.*, No. 2:18-cv-00546 (E.D. Tex.)

Counsel,

I write on behalf of Roku, Inc. ("Roku"), in response to the subpoena for the production of documents served on December 23rd, issued by you on behalf of your client, Canon, Inc. ("Canon"), related to the above-captioned matter ("the Action").

First, we appreciate your client's prior willingness to extend Roku's time to serve objections to the Subpoena up to and including January 13, 2020. Roku hereby timely objects to the Subpoena. Roku's responses and objections to Canon's subpoena for the production of documents are as follows.

General Objections

Roku hereby incorporates each of the following General Objections to Definitions as part of Roku's objections and responses to each of the requests stated in your subpoena:

Roku objects to the definition of "Roku" as vague, ambiguous, and overly broad to the extent that Canon includes within its definition entities other than Roku, Inc. Roku interprets this term as referring to Roku, Inc. only.

Roku objects to the definition of "Defendants" and "TCL" because it includes entities that are separate and distinct from the four entities that are current defendants in the Action. Roku will interpret these terms as referring solely to TCL Electronics Holdings Ltd., TCL Corporation, Shenzhen TCL New Technologies Co., Ltd., and TCL King Electrical Appliances (Huizhou) Co., Ltd.

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Roku objects to the definition of “Asserted Patents” as vague, ambiguous, overly broad, unduly burdensome, and not proportional to the needs of the case since the definition includes “the application from which each was issued, its entire prosecution history, any reexamination certificate, and all foreign counterparts, including foreign applications and foreign prosecution histories.” Roku interprets the term “Asserted Patents” to mean solely U.S. Patent Nos. 7,746,413, 8,078,767, 8,346,986, 8,713,206, and 7,810,130.

Roku objects to the term “Roku OS” as vague, ambiguous, overly broad, unduly burdensome, and not proportional to the needs of the case to the extent it includes versions of Roku’s operating system that are not incorporated into the products that Roku understands are accused by Canon in the Action. The scope of Canon’s definition of “Roku OS” suggests it is on a fishing expedition. Roku interprets “Roku OS” as versions of Roku’s operating system that are or have been incorporated into what Roku understands to be the accused products in the Action.

Roku objects to the definition of “TCL Roku TVs” as vague, ambiguous, overly broad, unduly burdensome, and not proportional to the needs of the case. Roku will interpret the term “TCL Roku TVs” to mean “Accused Products,” which Roku will interpret to be limited to the specific products identified in definition number 7 of the Subpoena.

Roku objects to the definition of “TCL Roku TV Remote Controls” as vague, ambiguous, overly broad, unduly burdensome, not proportional to the needs of the case, and requiring information not within Roku’s possession or control to the extent it requires Roku to determine remote controls “manufactured or provided by . . . TCL.” Roku is willing to consider a narrowed and clarified definition for this term. Until that time, Roku is unable to search for documents responsive to those requests that use this term.

Roku objects to the definition of “Roku iOS App” as vague, ambiguous, overly broad, unduly burdensome, not proportional to the needs of the case, and requiring information not within Roku’s possession or control to the extent it requires Roku to determine programs “used on an Apple smart phone or tablet.” Roku is willing to consider a narrowed and clarified definition for this term. Until that time, Roku is unable to search for documents responsive to those requests that use this term.

Roku objects to the definition of “Roku Android App” as vague, ambiguous, overly broad, unduly burdensome, not proportional to the needs of the case, and requiring information not within Roku’s possession or control to the extent it requires Roku to determine programs “used on an Android-based smart phone or tablet.” Roku is willing to consider a narrowed and clarified definition for this term. Until that time, Roku is unable to search for documents responsive to those requests that use this term.

Roku objects to the terms “Wired Connection” and “Wireless Connection” as vague, ambiguous, overly broad, unduly burdensome, and not proportional to the needs of the case, and as calling for a legal conclusion because the terms use claim terms from asserted claims that are or may

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be subject to dispute. Roku is willing to consider a revised definition that addresses these deficiencies. Until that time, Roku is unable to search for documents responsive to those requests that use these terms.

Roku objects to the term “Remote Control Device” to the extent it relies upon terms that have objectionable definitions.

Roku objects to the definition of “document” to the extent that it is inconsistent with the Federal Rules of Civil Procedure. Roku further objects to the definition of “document” as cumulative and overly broad to the extent it includes “drafts” regardless of whether the drafts are duplicative or cumulative.

Roku objects to the definition of “communication” to the extent that it is inconsistent with the Federal Rules of Civil Procedure.

Roku objects to the definition of “source code” as vague, ambiguous, overly broad, unduly burdensome, and not proportional to the needs of the case. Roku will interpret “source code” to have its commonly understood meaning in Roku’s industry.

Roku objects to the definition of the terms “sale,” “sells,” “sell” or “sold” as vague, ambiguous, overly broad, unduly burdensome, and not proportional to the needs of the case. Roku will interpret those terms consistent with their customary usage.

Roku objects to the extent the Subpoena exceeds the authority permitted under the Federal Rules of Civil Procedure or imposes any improper burden or costs on Roku not consistent with the Federal Rules of Civil Procedure.

Roku objects to the Subpoena to the requests are overbroad, not proportional to the needs of the case, or impose an undue and costly burden on Roku, including because they are not limited to the products or technologies accused in the Action, or to any issues in the litigation.

Roku objects to the requests to the extent any request may be construed as calling for the disclosure of information subject to the attorney-client privilege, the work-product doctrine, the joint defense or common-interest privilege, and/or any other applicable privilege, immunity or protection from discovery. Roku does not waive, intentionally or otherwise, any privilege or immunity that may be asserted to protect any information from disclosure.

Roku objects to all requests that call for documents or information “relevant” to a given topic or subject matter as, as calling for a legal and/or expert opinion, and as being vague, ambiguous, and undefined. Furthermore, Roku understands that Canon has designated as “Confidential” under the Protective Order in the Action Canon’s Infringement Contentions, preventing Roku from accessing or viewing those contentions, which hinders Roku’s ability to determine what information may be “relevant” to topics in Canon’s requests.

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Specific Objections and Responses

Roku objects to **RFP Nos. 1-4, 8-11, and 16-23** as overly broad, unduly burdensome, and disproportionate to the needs of the case to the extent they seek “all documents” in Roku’s possession, custody, or control. Roku has over 1600 employees in offices across the world. It is unduly burdensome and costly, and disproportionate to the needs of the case, to require Roku, a third party, to produce “all” documents related to a number of various topics.

Roku objects to **RFP Nos. 1-3, 8-11, 17-18, 21, and 23** as overly broad, unduly burdensome, and disproportionate to the needs of the case to the extent that they seek documents not related to the issues or functionalities at issue in the suit, and information that is available from the Defendants, such as communications between Defendants and Roku or documents otherwise exchanged between Defendants and Roku. These documents are properly requested from Defendants, and not Roku, a third party in this case. Roku further objects to these requests as cumulative and/or duplicative to the extent they seek documents and information already requested from Defendants to this action.

Roku objects to **RFP Nos. 1-3, 17-18, and 20-21** to the extent they call for information subject to the attorney-client privilege, including common interest privilege, or work-product privilege, or both.

Roku objects to **RFP Nos. 14, 16, and 19** as not reasonably related to Canon’s claims in this case to the extent that they seek documents and information regarding Roku’s finances. Roku is not a party to the Action.

Roku objects to **RFP Nos. 4, 7, 15, and 22** as not reasonably related to the claims and defenses in this case as pleaded in public filings. With respect to RFP Nos. 7 and 15, the manner in which Roku “ensure[s] interoperability of the hardware for the TCL Roku TVs” and Roku’s “custom advertising framework” are unrelated to the claims or defenses in the Action. With respect to RFP No. 22, depositions of Roku’s employees in an unrelated case regarding different asserted patents are not related to the present case, in which Roku is a third party. These requests have no bearing on any issue reasonably related to the claims in this action.

Roku objects to **RFP Nos. 3 and 16** as vague and ambiguous to the extent they rely on the phrases, respectively “activities and interactions” and “benefits (monetary and non-monetary).” These terms are undefined and could potentially encompass an unduly burdensome, overly broad scope of documents, to the extent those terms are capable of reasonably definite understanding.

Roku objects to **RFP Nos. 12 and 13** as vague and ambiguous to the extent they use terms that overlap with the claim language in the patents asserted in this action. In responding to these requests, Roku does not represent that Roku OS or accused products meet any limitation of the asserted patents. Roku interprets the functionalities (a)-(g) in these requests in accordance with the functionalities accused in Canon’s First Amended Complaint in the Action.

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Roku objects to **RFP No. 23** as overly broad, unduly burdensome, and disproportionate to the needs of the case to the extent it requests “all documents and communications” sufficient to show the involvement of the enumerated twenty employees with “any TCL Roku TV.”

Roku reserves the right at thy time to revise, correct, add to, or clarify the foregoing objections.

In view of the foregoing objections, Roku will not produce documents pursuant to the Subpoena at this time, but is willing to work with you and your client to determine a proper scope for the Subpoena and is open to discussing this matter further. Roku is, however, in the process of conducting a reasonable search for source code that relates to the allegations of Canon’s First Amended Complaint.

Regards,

/s/ Andrew T. Radsch

Andrew T. Radsch

From: Radsch, Andrew
Sent: Sunday, January 26, 2020 4:37 PM
To: Lee, Alexander H.; Yen, Bruce; Taylor, Scott; Thomases, Andrew
Cc: TCL-Canon; Ropes-TCL-Canon-Service; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com
Subject: RE: Canon v. TCL - Subpoenas to Roku Inc

Alex,

Roku continues to object to a number of Canon's requests for the reasons set forth in its previously served objections. For several of Canon's requests, Canon has made no effort to clarify or narrow them, or to explain their relevance or how they are proportional to the needs of the case. For others, Canon's modified requests remain problematic. In particular:

- A number of your requests continue to use the defined term "TCL," even though I explained to you why Canon's definition for that term is overbroad. During the meet and confer, I asked you to identify the persons and legal entities falling within that definition, but you could not provide that information. It is not clear to me how Roku is expected to know the identity of all "subsidiaries, affiliates, divisions, successors, or assignees, and their respective officers, directors, employees, consultants, contractors, representatives, and agents" of the named Defendants and of the subsidiaries of the named Defendants. Roku will interpret "TCL" (and "Defendants") to refer to the named Defendants that remain in the litigation. To be clear, Roku maintains all of its objections to Canon's other definitions in its subpoena for the reasons previously described in my letter and in our meet and confer.
- Regarding RFP 1, Roku will conduct a reasonable search for the License and Distribution Agreement between it and TTE and any relevant amendments thereto.
- Regarding RFP 2, the request remains overbroad, to the extent it requests "all documents." Roku will conduct a reasonable search for documents sufficient to evidence the information requested, subject to Roku's objections to the defined terms used.
- RFP 4 remains overbroad as it is not limited to the products or issues in this litigation—confirming again that Canon appears to be fishing for other information from Roku.
- For RFPs 5 and 6, please state more clearly and specifically what information you are looking for and explain why that information is necessary, relevant, and proportional (particularly as those requests are not limited to the accused (alleged) features/functionalities), particularly in view of Roku's anticipated production of source code.
- RFP 7 remains objectionable including because it remains overbroad and not proportional to the needs of the case.
- With respect to RFPs 8-11, they remain overbroad because they are not limited to the accused (alleged) features/functionalities of the accused products, but instead request documents sufficient to show all operations of the accused products and Roku apps, again demonstrating that Canon is overreaching.
- RFPs 14-23 remain objectionable for reasons already stated. Canon has made virtually no effort to address Roku's objections to those requests.

As I have previously explained, Roku is willing and eager to work with Canon on an appropriate scope of Canon's subpoena, but Canon has made little effort to narrow or clarify its sweepingly broad and oftentimes irrelevant requests. Roku will continue to reasonably work through these issues with Canon, and I will be available to meet and confer as necessary.

Regards,
Andrew

Andrew T. Radsch

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1900 University Avenue, 6th Floor

East Palo Alto, CA 94303

andrew.radsch@ropesgray.com

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From: Lee, Alexander H. <alexanderlee@paulhastings.com>

Sent: Friday, January 24, 2020 10:33 PM

To: Radsch, Andrew <Andrew.Radsch@ropesgray.com>; Yen, Bruce <bruceyen@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>

Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com

Subject: RE: Canon v. TCL - Subpoenas to Roku Inc

[EXTERNAL]

Andrew,

Thank you for confirming receipt of Canon's updated requests.

Canon is not making any changes to the definitions of terms, which have been used in its already narrowed-down requests.

Thanks,

Alex.

From: Radsch, Andrew [<mailto:Andrew.Radsch@ropesgray.com>]

Sent: Friday, January 24, 2020 8:54 PM

To: Lee, Alexander H.; Yen, Bruce; Taylor, Scott; Thomases, Andrew

Cc: TCL-Canon; Ropes-TCL-Canon-Service; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com

Subject: [EXT] RE: Canon v. TCL - Subpoenas to Roku Inc

Alex,

Thank you, we will consider this and discuss with Roku. Is Canon maintaining its definitions to which Roku objected?

Andrew

Andrew T. Radsch

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From: Lee, Alexander H. <alexanderlee@paulhastings.com>
Sent: Friday, January 24, 2020 7:27 PM
To: Radsch, Andrew <Andrew.Radsch@ropesgray.com>; Yen, Bruce <bruceyen@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>
Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com
Subject: RE: Canon v. TCL - Subpoenas to Roku Inc

Andrew,

Thank you for your response. To reduce the burden upon Roku, Canon will narrow its below requests to Roku.

- RFP No. 1: All agreements between You and TCL relating to Accused Products including any TCL Roku TVs, TCL Roku TV Remote Controls, Roku iOS App, Roku Android App, or Remote Control Device.
- RFP No. 3: Canon withdraws this request.
- RFP No. 4: The "smart TV hardware reference design," and documents sufficient to show "the development, planning, manufacturing and marketing" of Roku TVs referenced in statement on page 7 of Your 2019 10-K Annual Report (<https://ir.roku.com/static-files/195156b3-38a1-4c31-8656-b968101924ba>) ("Roku TVs integrate our Roku Operating System, or Roku OS, and leverage our smart TV hardware reference design. We work with our TV brand licensees to assist in all phases of the development of Roku TVs, including development, planning, manufacturing and marketing.").
- RFP No. 5: Documents sufficient to show the process of integrating Roku OS with the Accused Products.
- RFP No. 6: Documents sufficient to show the testing and quality assurance processes of the Accused Products.
- RFP No. 8: "All documents concerning the structure, architecture, and/or design" refer to "Documents sufficient to show the structure, architecture, and design"
- RFP Nos. 9-11: "All documents concerning the structure, architecture, and/or operation" refer to "Documents sufficient to show the structure, architecture, and operation"
- RFP No. 16: "All documents relating to" refer to "Documents sufficient to show"
- RFP No. 23: "All documents" refer to "Documents"

Canon is available to meet and confer regarding the above and any other requests.

Thanks,
Alex.

From: Radsch, Andrew <Andrew.Radsch@ropesgray.com>
Sent: Friday, January 24, 2020 8:32 AM
To: Yen, Bruce <bruceyen@paulhastings.com>; Lee, Alexander H. <alexanderlee@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>
Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com
Subject: [EXT] RE: Canon v. TCL - Subpoenas to Roku Inc

Alex,

As we discussed last week during our meet and confer on your subpoena to Roku, Canon would be providing a revised/narrowed set of document requests to address the defects of its document subpoena. As we discussed, the current requests are overbroad for many reasons. When you suggested that Roku should start searching for documents responsive to the more narrow requests, I asked you to identify which more "narrow" requests you were referring to, but you were unable to point to any, and instead stated that you would follow up with revised requests.

I emphasized the importance of Canon providing revised requests to us promptly as Roku is eager to reach agreement on an appropriate scope of discovery of it so that Roku can move forward with searching for and providing that discovery. I reiterated this same point to your colleague, Kyo, this week. Nevertheless we have not received that revised list.

When can we expect that information?

Best,
Andrew

Andrew T. Radsch
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andrew.radsch@ropesgray.com
www.ropesgray.com

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From: Radsch, Andrew <Andrew.Radsch@ropesgray.com>
Sent: Monday, January 13, 2020 5:37 PM
To: Yen, Bruce <bruceyen@paulhastings.com>; Lee, Alexander H. <alexanderlee@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>
Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com
Subject: RE: Canon v. TCL - Subpoenas to Roku Inc

Counsel,

Pursuant to the agreement of the parties to extend Roku, Inc.'s ("Roku") deadline to serve objections to Canon's subpoena for the production of documents, attached are said objections.

As noted in the attached, Canon's document requests are objectionable for many reasons and therefore Roku will not be producing documents at this time in response to the subpoena. Roku is certainly willing, however, to discuss Canon's requests and Roku's objections, and to work with you on identifying a scope of requests that are appropriate and proportional to the needs of the case. In addition, as noted in the attached, Roku is in the process of conducting a reasonable search for source code and will make available for inspection such source code if and when such source code is located after a reasonable search.

Roku also objects to the deposition topics in Attachment A of Canon's deposition subpoena because, among other reasons, they are vague, ambiguous, overbroad, unduly burdensome, not proportional to the needs of the case, fail to describe with reasonable particularity the matters for examination, and to the extent they call for privileged, work-product, or other information that is otherwise immune from discovery. Roku is also willing to meet and confer as to (a) an appropriate and proportional scope of the deposition topics, and (b) a mutually convenient date and time for any such deposition.

Best regards,
Andrew

Andrew T. Radsch

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From: Yen, Bruce <bruceyen@paulhastings.com>

Sent: Thursday, January 02, 2020 4:48 PM

To: Radsch, Andrew <Andrew.Radsch@ropesgray.com>; Lee, Alexander H. <alexanderlee@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>

Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com

Subject: RE: Canon v. TCL - Subpoenas to Roku Inc

Hi Andrew,

Canon does not object to a one-week extension to serve any objections to Canon's subpoena for the production of documents and things. Out of an abundance of caution, we note that this does not extend the deadline specified in the subpoena for Roku to produce documents and things responsive to the subpoena.

Thank you,

Bruce

From: Radsch, Andrew <Andrew.Radsch@ropesgray.com>

Sent: Thursday, January 2, 2020 12:28 PM

To: Lee, Alexander H. <alexanderlee@paulhastings.com>; Yen, Bruce <bruceyen@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>

Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com

Subject: [EXT] RE: Canon v. TCL - Subpoenas to Roku Inc

Counsel,

In view of the intervening holidays, Roku requests a one week extension of time to serve any objections to Canon's subpoena for the production of documents that was served on December 23. Please confirm this is acceptable to Canon.

Thanks,
Andrew

Andrew T. Radsch

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andrew.radsch@ropesgray.com

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From: Lee, Alexander H. <alexanderlee@paulhastings.com>
Sent: Friday, December 20, 2019 4:31 PM
To: Radsch, Andrew <Andrew.Radsch@ropesgray.com>; Yen, Bruce <bruceyen@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>
Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com
Subject: RE: Canon v. TCL - Subpoenas to Roku Inc

Andrew R,

Please be advised that the missing annual statement was referring to Roku's 2019 10-K Annual Report (<https://ir.roku.com/static-files/195156b3-38a1-4c31-8656-b968101924ba>). Here is the revised subpoena that has fixed the typo. We will serve this revised subpoena on Ropes soon.

Thanks,
Alex.

From: Lee, Alexander H.
Sent: Friday, December 20, 2019 2:23 PM
To: 'Radsch, Andrew' <Andrew.Radsch@ropesgray.com>; Yen, Bruce <bruceyen@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>
Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com
Subject: RE: Canon v. TCL - Subpoenas to Roku Inc

Andrew R,

Thanks for letting us know. We will provide Ropes with service of Canon's subpoena to Roku, including the required witness fee and the missing Annual Statement.

Thanks,
Alex.

From: Radsch, Andrew <Andrew.Radsch@ropesgray.com>
Sent: Friday, December 20, 2019 1:54 PM
To: Yen, Bruce <bruceyen@paulhastings.com>; Lee, Alexander H. <alexanderlee@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>
Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com
Subject: [EXT] RE: Canon v. TCL - Subpoenas to Roku Inc

Bruce,

We are authorized to accept service of Canon's subpoena on behalf of Roku. Please be sure to provide us with a complete and proper service, e.g., including tendering of the required witness fee, and including the Annual Statement referenced in the subpoena as being attached but that is not in fact attached.

Andrew

Andrew T. Radsch
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From: Yen, Bruce <bruceyen@paulhastings.com>
Sent: Friday, December 20, 2019 11:31 AM
To: Radsch, Andrew <Andrew.Radsch@ropesgray.com>; Lee, Alexander H. <alexanderlee@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>
Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com
Subject: RE: Canon v. TCL - Subpoenas to Roku Inc

Hi Andrew,

Perhaps we are mistaken, but we thought there was some discussion earlier in the case that indicated that Ropes may represent Roku in relation to this matter, and as a result that you might be able to readily accept electronic service. We otherwise have no issue serving Roku's agent if you're unable to confirm authorization by early afternoon.

Thank you,

Bruce

From: Radsch, Andrew <Andrew.Radsch@ropesgray.com>
Sent: Friday, December 20, 2019 10:57 AM
To: Lee, Alexander H. <alexanderlee@paulhastings.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>
Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com
Subject: [EXT] RE: Canon v. TCL - Subpoenas to Roku Inc

Alex,

Your request that a third-party confirm on only 2.5 hours' notice whether Ropes & Gray is authorized to accept service of a subpoena is unreasonable.

We will look into your request and get back to you in due course.

Andrew

Andrew T. Radsch

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www.ropesgray.com

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From: Lee, Alexander H. <alexanderlee@paulhastings.com>

Sent: Friday, December 20, 2019 10:32 AM

To: Taylor, Scott <Scott.Taylor@ropesgray.com>; Thomases, Andrew <Andrew.Thomases@ropesgray.com>; Radsch, Andrew <Andrew.Radsch@ropesgray.com>

Cc: TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; idoan@haltomdoan.com; ithane@haltomdoan.com; gil@gillamsmithlaw.com

Subject: Canon v. TCL - Subpoenas to Roku Inc

PRIVILEGED AND CONFIDENTIAL

Counsel,

Please find attached herewith Canon's subpoenas to testify and to produce documents to Roku Inc. We are providing service of process on Ropes & Gray, which has represented Roku Inc. in this matter.

Please let us know if Ropes & Gray can accept service of the attached subpoenas electronically on behalf of Roku Inc. by **1 pm (PT)/4pm (ET) today.**

Thanks,
Alex.

**PAUL
HASTINGS**

Alexander Lee | Associate, Litigation Department

Paul Hastings LLP | 1117 S. California Avenue, Palo Alto, CA 94304 | Direct: +1.650.320
| Main: +1.650.320.1800 | Fax: +1.650.320.1997 | alexanderlee@paulhastings.com |
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From: LeGolvan, Andy <andylegolvan@paulhastings.com>
Sent: Friday, April 24, 2020 1:42 PM
To: Radsch, Andrew
Cc: Thomases, Andrew; Taylor, Scott; TCL-Canon; Ropes-TCL-Canon-Service; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com; wrlamb@gillamsmithlaw.com
Subject: RE: Canon v TCL, No. 18-cv-546-JRG - Document Production Status

Andrew,

Please provide an updated status on the TCL Zoom source code and documents relating to sales projections and sales forecasts today (first and second bullet point in my April 22 email). We need to know a date certain by which both of these categories will be complete. Given the schedule, and Defendants' repeated delays in producing relevant documents, we cannot tolerate any further delay. If we do not receive a status update today, with specific explanation of what is being collected and produced, we will be filing a motion to compel.

Additionally, regarding the alternatives documents (third bullet point in my April 22 email), please describe in detail what you mean when you say the production is "largely complete." Again, given the schedule and the delays in Defendants' productions, we will be filing a motion to compel if we do not have a specific status update from you today.

Further, regarding the fourth bullet point in my April 22 email, you represented that Roku has completed its production of licenses and related agreements, including agreements that provide Roku with revenue from the use or sale of the accused products such as channel developer, content publisher, and CDN provider agreements as requested in RFP No. 19. However, we have seen no channel developer, content publisher, and CDN provider agreements in Roku's document production. Such agreements are relevant to the revenue that Roku makes from the accused products, as Roku itself has represented in its 10-K filings: "We license the Roku OS and our smart TV hardware reference designs to certain TV brands to manufacture co-branded smart TVs. The primary economic benefits that we derive from these license arrangements have been and will likely continue to be indirect, primarily from growing our active accounts and increasing streaming hours on our platform." <https://ir.roku.com/static-files/cd9f1b20-16f9-4b68-9438-09cd9c630929> (2019 10-K) at 17. Given the parties are at an impasse on this category, Canon will be filing a motion to compel.

Finally, as we discussed during our lead and local meet and confer on Monday, Roku's production of financial information is deficient. See RFP Nos. 14, 16. Therefore, Canon will be filing a motion to compel on this category as well. Canon's subpoena (which, again, was served over four months ago), requested documents relating to Roku's finances with respect to use of the accused products, including specific categories of information:

RFP No. 14: "Documents sufficient to show the quarterly revenue of any collateral or conveyed products or services sold in the United States involving the use of an Accused Product between 2014 and present, including but not limited to: (a) Total revenues (gross and net revenues); (b) Revenues from licensing Roku platform to TCL; (c) Number of active accounts using Accused TVs; (d) Revenues derived from video advertisement played on Accused TVs; (e) Revenues derived from subscriptions of streaming content on Accused TVs; (f) Number of streamed hours on Accused TVs; (g) Number of units sold; (h) Gross margin; (i) Operating costs; (j) Operating margin; (k) Net margin; and (l) Net profits."

RFP No. 16: "All documents relating to the benefits (monetary and non-monetary) You received (or expected to receive) from the Accused Products being sold and used in the United States, including, but not limited to, projected, expected, or actual impact that the Accused Products had on Your sales of

other products or services. To the extent possible, the information identified in this request should be broken down by model of the Accused Products.”

On Monday’s meet and confer call, you represented that the “primary document” Roku produced in response to these RFPs was the financial spreadsheet at ROKU-CANON_0000025253, which only lists number of units sold and some form of revenue, and is missing most of the information that Canon requested, such as number of active accounts using the accused TV among several others. The spreadsheet lists a total of less than \$3 million attributed to TCL between 2014 and 2019. The \$3 million total that the spreadsheet attributes to Roku’s biggest smart TV partner over the course of six years is less than 0.8% of Roku’s Platform net revenue that it reported in 2019 alone (\$388 million). <https://ir.roku.com/static-files/cd9f1b20-16f9-4b68-9438-09cd9c630929> (2019 10-K) at 57; <https://www.morningstar.com/news/accesswire/577502msn/tv-brand-streaming-mediaboosts-performance-and-share-prices-of-roku-and-tcl-electronics> (“over 60% of Roku TVs nationwide are TCL Roku TV”). Indeed, Roku received more than that amount in licensing fees from TCL in 2016 alone (as well as in 2017 and 2018). See ROKU-CANON_0000000231.

It is simply not credible that Roku does not keep documentation providing further detail as to the amount of revenue Roku generates from TCL Roku TVs, as Roku must have some means of assessing the value of its partnership with TCL and other TV manufacturers. For example, Roku has stated in its public filings that its business model focuses on increasing the number of active accounts that use its streaming platform. <https://ir.roku.com/static-files/cd9f1b20-16f9-4b68-9438-09cd9c630929> (2019 10-K) at 5. Surely Roku must keep information as to the number of active accounts that each of its TV manufacturer partners generates when this metric is the core of its business. Roku’s founder and CEO Anthony Wood has implied that Roku keeps track of such metrics for TCL when he publicly stated at CES 2018 that “[w]orking with companies like TCL is the fastest way we grow our active accounts.” TCL-CANON_0000031914 at 31946.

Given the schedule and Roku and Defendants’ repeated delays in producing relevant documents, Canon cannot wait until a deposition of a Roku finance witness to find out that Roku has substantially failed to comply with its discovery obligations. Therefore, we intend to bring this issue to the Court right away.

Finally, please also confirm that, aside from the outstanding issues described herein, Defendants, Roku, and TTE’s document productions are complete.

Thanks,
Andy

From: Radsch, Andrew <Andrew.Radsch@ropesgray.com>
Sent: Wednesday, April 22, 2020 10:54 PM
To: LeGolvan, Andy <andylegolvan@paulhastings.com>
Cc: Thomases, Andrew <Andrew.Thomases@ropesgray.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com; wrlamb@gillamsmithlaw.com
Subject: [EXT] RE: Canon v TCL, No. 18-cv-546-JRG - Document Production Status

Andy,

Defendants’ investigation into source code for the TCL Zoom remote, which you first identified last week and which does not form any basis of your contentions in this case, is ongoing. Defendants are working diligently to run those questions to ground. Regarding your second bullet, additional forecast information was produced yesterday, and Defendants continue to conduct a reasonable additional search. We hope to run both to ground this week. As to your third bullet, Defendants’ production is largely complete.

Regarding your fourth bullet, Roku’s production is complete.

Andrew

Andrew T. Radsch
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From: LeGolván, Andy <andylegolvan@paulhastings.com>

Sent: Wednesday, April 22, 2020 1:58 PM

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Subject: Canon v TCL, No. 18-cv-546-JRG - Document Production Status

Andrew,

On the April 20 lead/local meet-and-confer call, you agreed to provide a status update by today on the following outstanding document and source code production issues that relate to both Defendants and Roku (where specified). Please confirm you are on track to provide that update today.

- Status of Defendants' production of TCL Zoom remote control source code
- Status of Defendants' production of documents relating to sales projections and sales forecasts of TCL Roku TVs between 2014 and 2024, including projections and forecasts specific to the Accused Products. Recall that you agreed on the call to produce responsive documents for the full timeframe.
- Status of Defendants' production of documents relating to the alternatives Defendants have considered with respect to the accused functionalities and documents relating to the actual or projected costs to the alternatives. As we agreed on the call, this would include, without limitation, alternatives to Roku OS that Defendants considered (e.g., operating systems developed by others, developing their own operating system, etc.), and documents relating to the actual or projected costs to the alternatives.
- Status of Roku's license agreement production and production of related agreements. This would include the status of production of the channel developer, content publisher, and CDN provider agreements that were explicitly requested in RFP No. 19, and other agreements that provide Roku with revenue from the use or sale of the accused products (also covered by RFP No. 19).

Thanks,
Andy



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EXHIBIT F

FILED UNDER SEAL



US007746413B2

(12) **United States Patent**
Aoyama et al.

(10) **Patent No.:** US 7,746,413 B2
(45) **Date of Patent:** Jun. 29, 2010

(54) **OPERATION SCREEN CONTROLLING METHOD, OPERATION SCREEN CONTROLLING PROGRAM, AND DISPLAY DEVICE**

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(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 566 days.

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Related U.S. Application Data
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May 25, 2004 (JP) 2004-154154

(51) **Int. Cl.**
H04N 5/50 (2006.01)

(52) **U.S. Cl.** 348/734

(58) **Field of Classification Search** 348/734,
348/725, 706; 725/139, 140, 141, 10, 11;
340/825.72, 825.69

See application file for complete search history.

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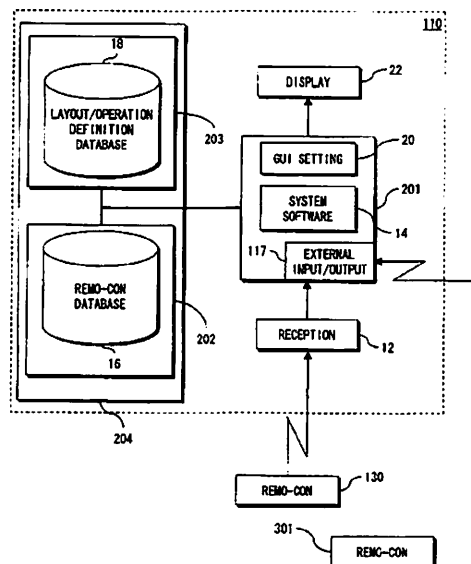
Primary Examiner Paulos M Natnael

(74) *Attorney, Agent, or Firm*—Fitzpatrick, Cella, Harper & Scinto

(57) **ABSTRACT**

A controlling method of an operation screen for operations of a remote control device, includes the steps of acquiring an attribute of a remote control device, and determining an operation form corresponding to the remote control device from among a plurality of operation forms previously stored based on the acquired attribute of the remote control device. An additional step includes displaying an operation screen related to the determined operation form displayed.

11 Claims, 10 Drawing Sheets



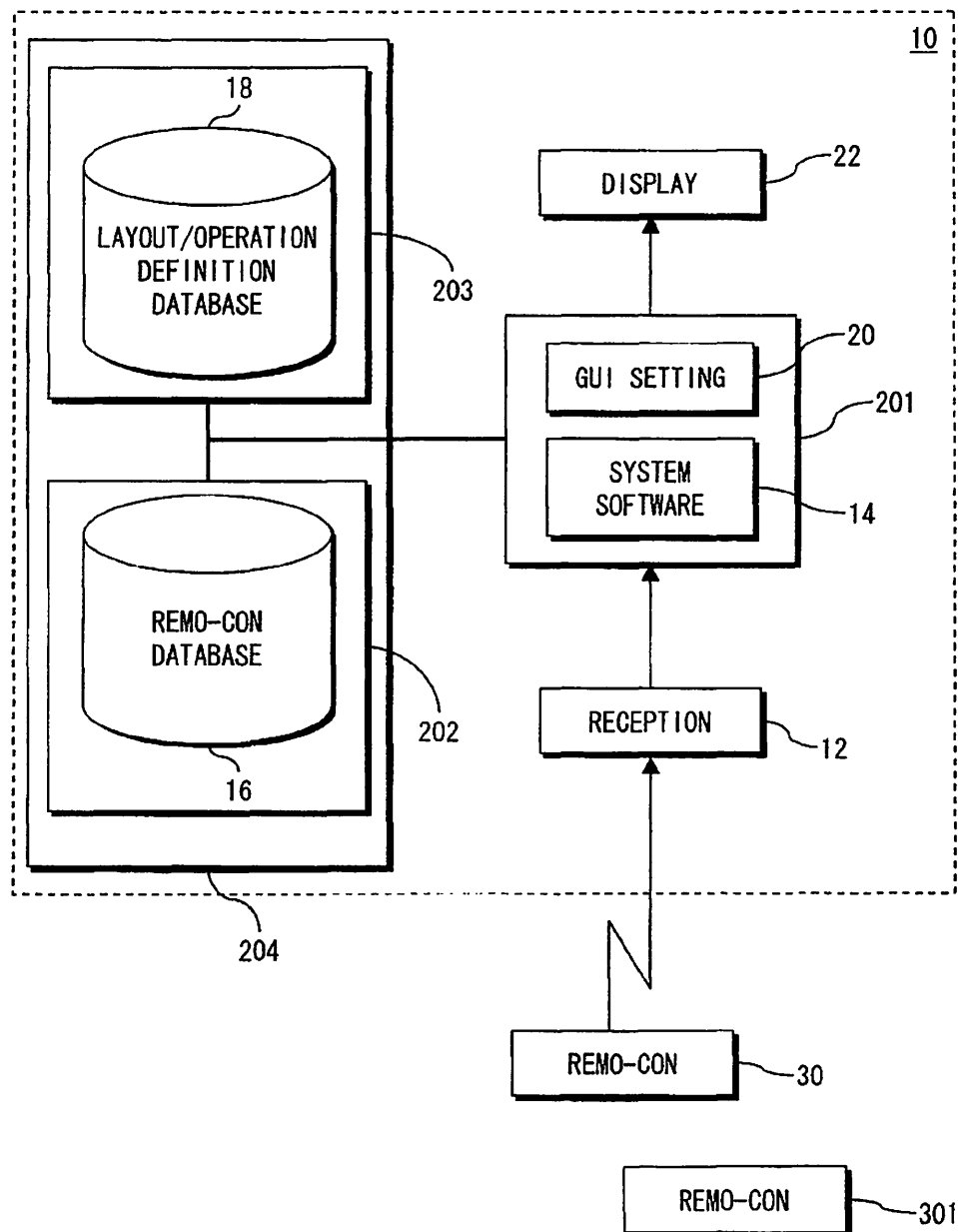
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Fig. 1

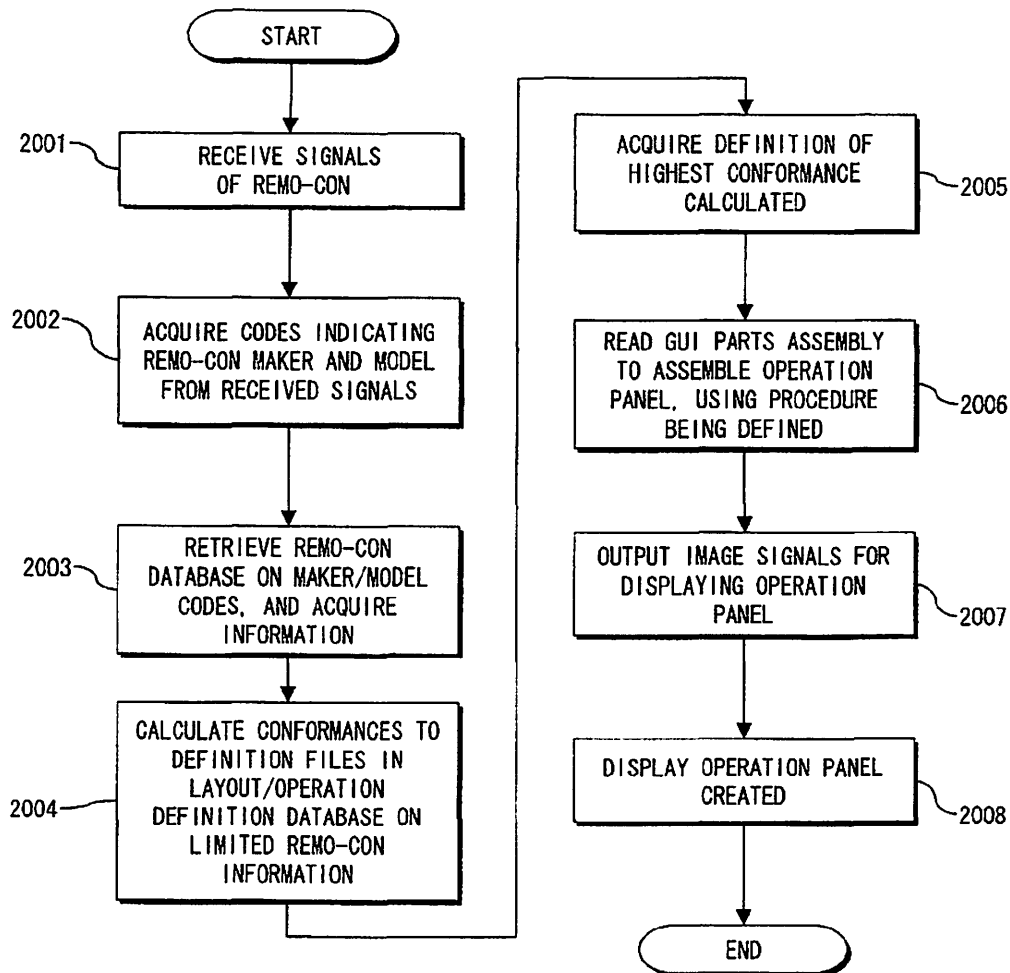


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Fig. 2

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Fig. 3

MAKER CODE	MODEL CODE	OPERATION DEVICE INFORMATION			
		POINTING DEVICE	TEN KEY	LIQUID CRYSTAL TOUCH PANEL	DIAL DEVICE
S	01	◎	○	○	○
P	4	×	◎	×	×
N	00	×	×	◎	×
T	13	×	◎	×	×
S P	2	○	◎	×	×
D	5	◎	○	×	×

◎ : MOUNTED ON REMO-CON (MOST ACCESSIBLE ON HAND)

○ : MOUNTED ON REMO-CON

× : UNMOUNTED ON REMO-CON

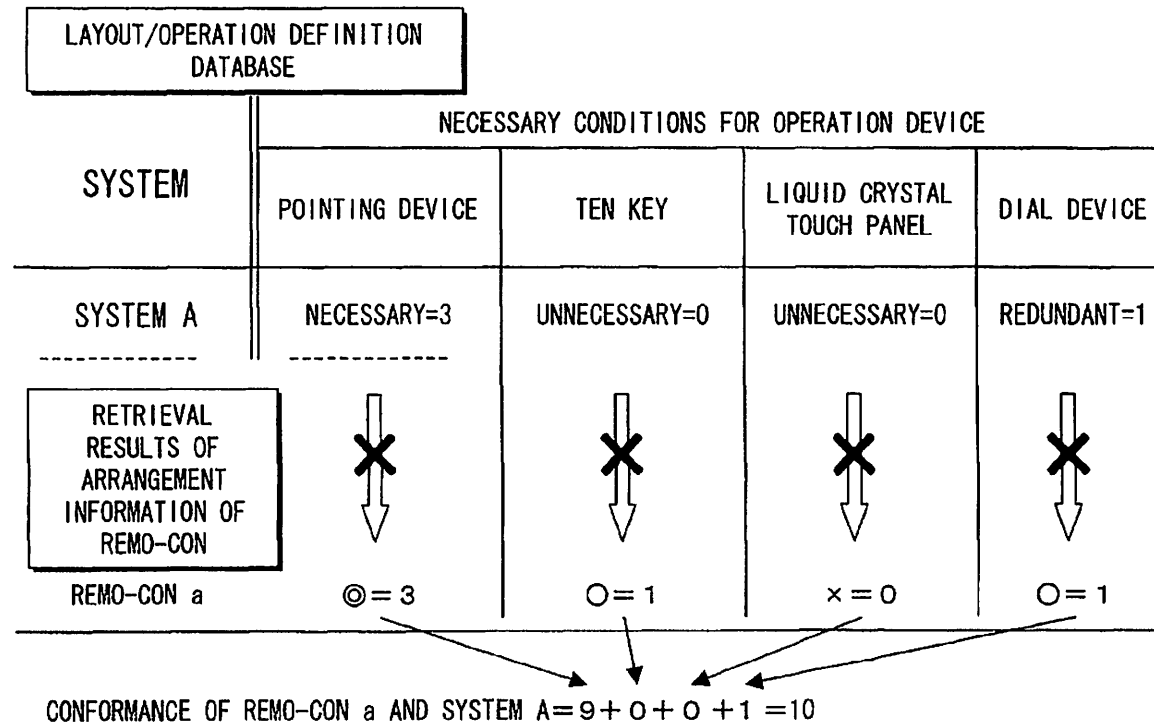


Fig.4

Fig. 5

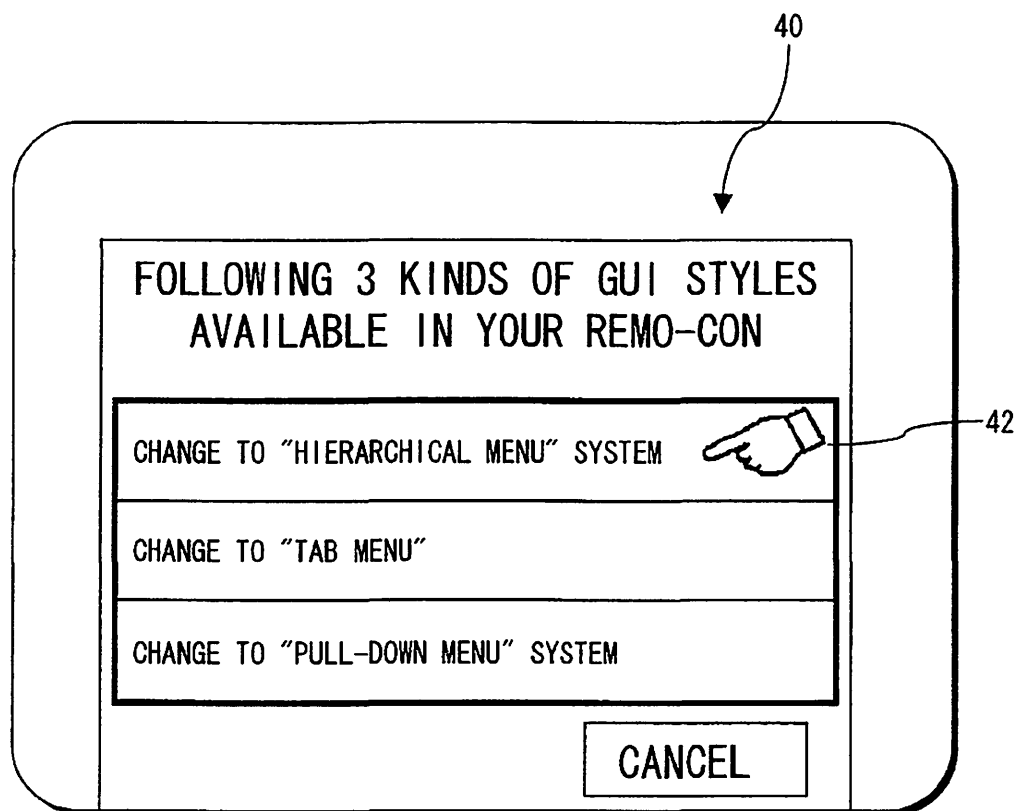
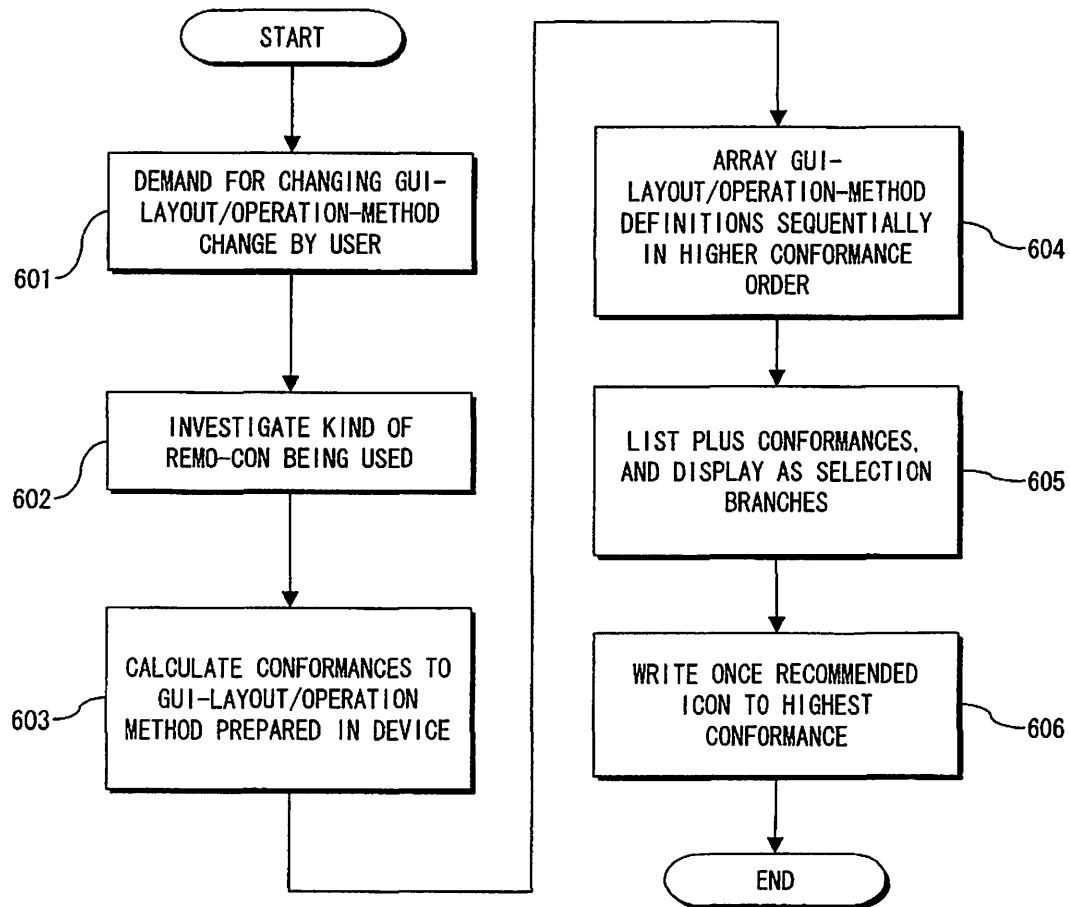


Fig. 6

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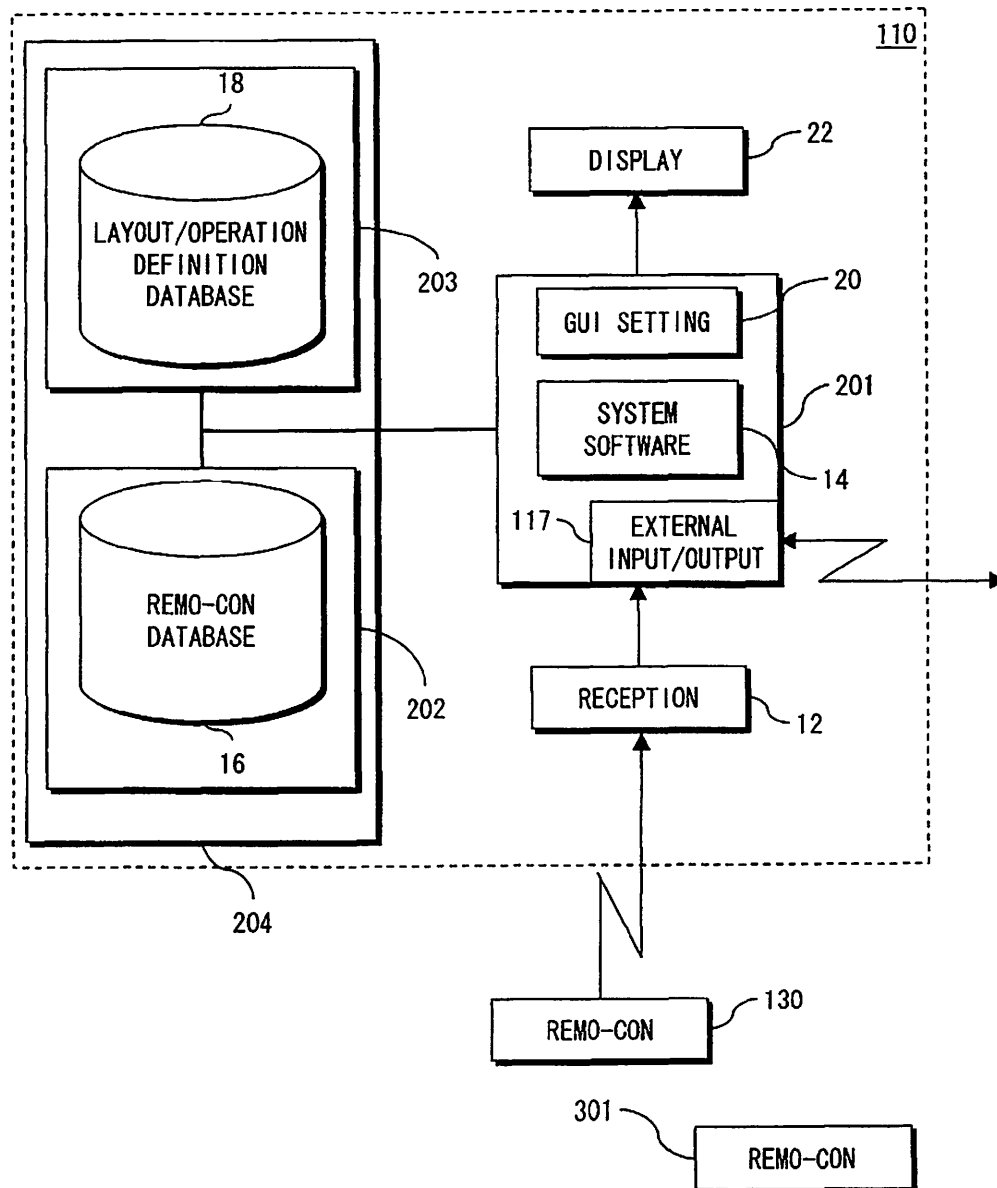
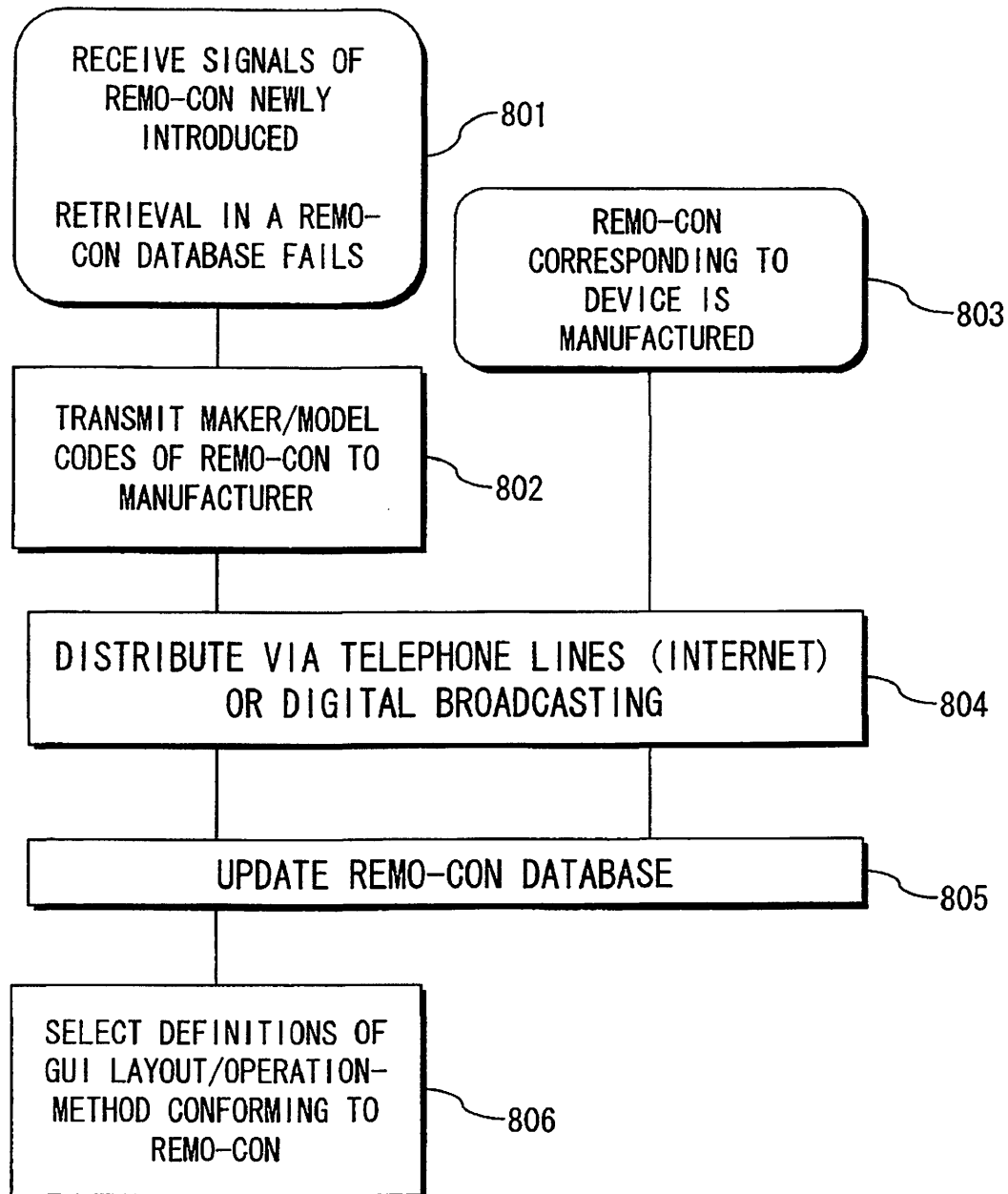
Fig. 7

Fig. 8

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Fig. 9

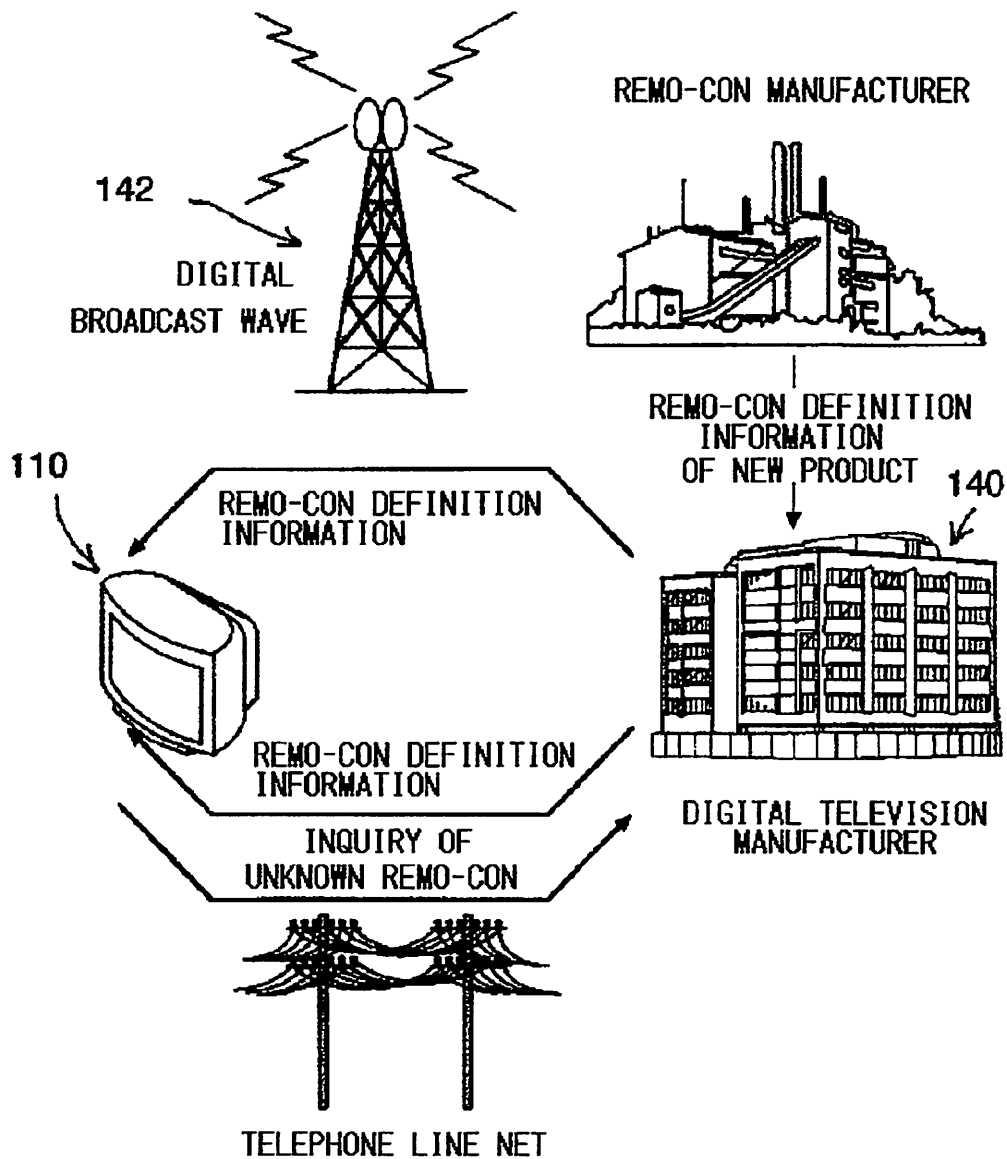
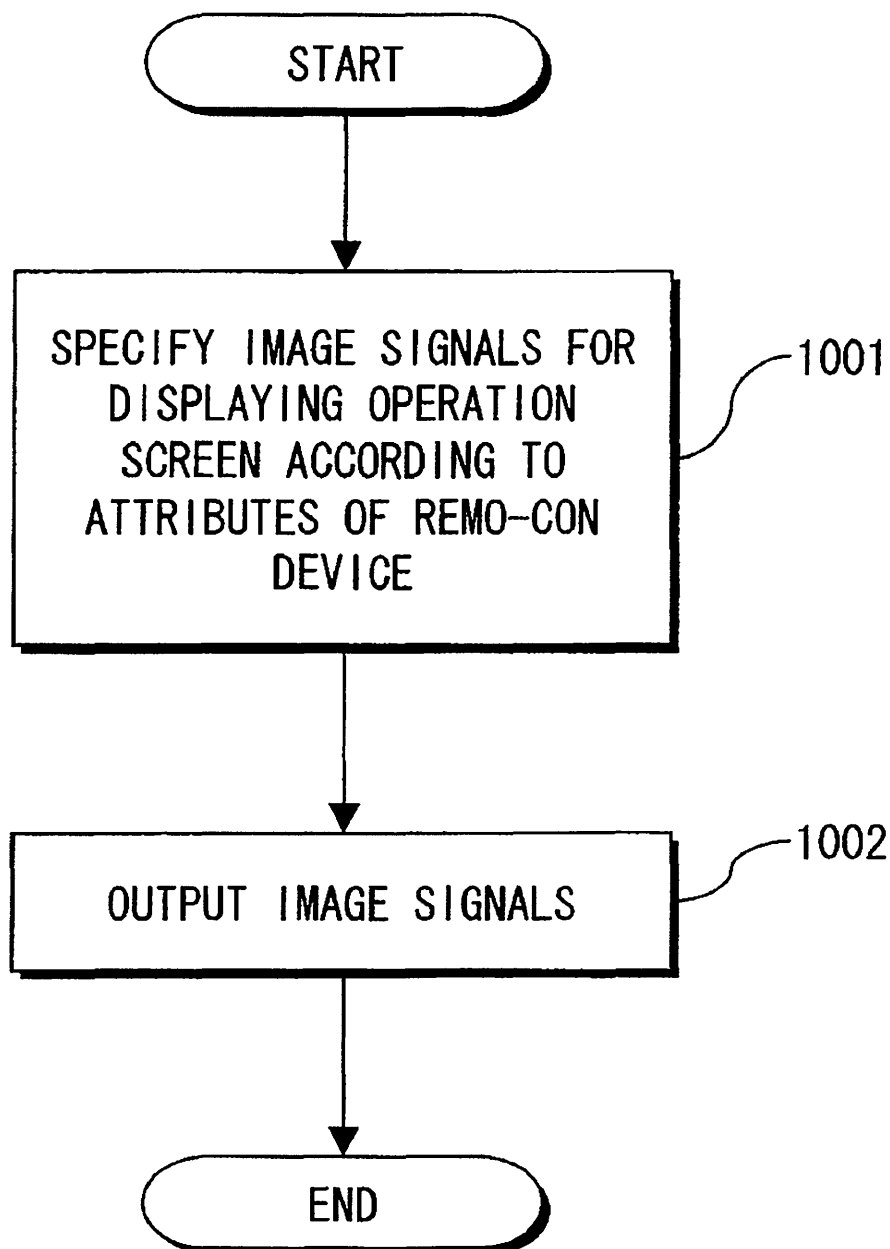


Fig. 10



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OPERATION SCREEN CONTROLLING METHOD, OPERATION SCREEN CONTROLLING PROGRAM, AND DISPLAY DEVICE

This is a continuation of Application Ser. No. 10/854,231, filed on May 27, 2004.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an operation screen controlling method, an operation screen controlling program and a display device and, more particularly, to a control method of an operation screen having relations to the operations of a remote control device.

2. Description of the Related Art

In case a plurality of remote control devices for controlling a television receiver are used, as disclosed in JP-A-2001-61110, there has been proposed a television receiver, which is enabled to use a plurality of remote control devices (as abbreviated into the "remo-con") by giving priority to the individual remote control devices to improve the operability of the television receiver.

SUMMARY OF THE INVENTION

Depending on the operation screen of a graphical user interface, however, the operability may be degraded by the remote control device used.

Therefore, an object of the invention is to provide an operation screen controlling method, an operation screen controlling program and a display device, which can eliminate those disadvantages.

In order to achieve the object, in a remote control system according to the invention, there is provided an operation screen controlling method which comprises: the step of specifying image signals for displaying an operation screen, according to the attributes of a remote control device; and the step of outputting the image signals.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with further advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram schematically showing a construction of a display device according to a first embodiment of the invention;

FIG. 2 is a flow chart showing a flow of changing the GUI layout and operation methods according to the first embodiment of the invention;

FIG. 3 is a diagram showing one example of data in a remote control database;

FIG. 4 is a chart showing a flow of calculating the conformances of the GUI layout and the operation methods;

FIG. 5 is a diagram showing an example of an operation screen for changing the GUI layout and the operation methods;

FIG. 6 is a flow chart showing a flow of works for selecting the available change definitions of the GUI layout and the operation methods;

FIG. 7 is a block diagram schematically showing a construction of a display device according to a second embodiment of the invention;

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FIG. 8 is a chart showing a flow of works to add information to the remote control database;

FIG. 9 is a diagram showing a flow of definition information of a remote control device in the outside; and

FIG. 10 is a flow chart showing a flow of an operation screen controlling method according to an embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the invention will be described with reference to the accompanying drawings. FIG. 10 shows a flow of an operation screen controlling method according to an embodiment of the invention.

In the embodiment of the invention, as shown in FIG. 10, image signals for displaying an operation screen are specified at first in Step 1001 in accordance with the attributes of a remote control device. After this, the routine transfers to Step 1002, at which the specified image signals are outputted. Here, the attributes of the remote control device in the invention are characteristics intrinsic to the remote control device. Moreover, these intrinsic characteristics of the remote control device are the identification information itself for identifying a plurality of remote control devices from one another, and whether or not the remote control device is provided with a pointing device such as a cross key for moving a pointer or focus position on the screen or a specific operation device such as a numeral key.

On the other hand, the operation screen is constructed of either a display element corresponding to the operation device owned by the remote control device or a display element corresponding to such a specific operation of the remote control device as can be performed by the user. As the operation screen, a screen containing an image indicating that numeral key can be adopted as a display element corresponding to a predetermined numeral key provided in the remote control device. Moreover, a screen containing the image indicating the cross key can be adopted as the display element corresponding to the cross key of the remote control device.

In these cases, the display element is desirably an element for displaying the numeral key disposed in the remote control device or the mode of an operation device such as a bonding device precisely. However, the display element should not necessarily be limited to the image for displaying the mode of the operation device but may be a state, in which the user can recognize the corresponding relation between the operation device of the remote control device and the image contained by the operation screen. Moreover, the display element is preferred to have the construction, in which the operation screen contains at least one display element corresponding one-by-one to the operation device owned by the remote control device, but should not necessarily be limited to the construction. Specifically, the operation screen can be one containing such a plurality of selection branches for display elements as are to be selected by a specific operation of the pointing device of the remote control device, for example, by a depression of the cross key to be designated four upward, downward, leftward and downward directions, such as the images of a plurality of tabs to be sequentially selected by the specific operation. Preferably, it is possible to adopt the construction, in which the individual images (as will be called the "graphical user interface (GUI) parts") as the display elements are stored individually in storage devices. In case the operation screen containing the display elements is to be displayed, the images or the display elements can be combined to produce the image signals for displaying the opera-

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tion screen. It is also preferably possible to adopt the construction, in which the information indicating the arrangement relation of the display elements, that is, the layout information is determined according to the attributes of the remote control device. However, it is unnecessary to store the display elements individually as different images. For example, it is possible to store one image containing a plurality of display elements such as an image displaying the entirety of the remote control device having a plurality of display elements. In this case, the image displaying the entire remote control device may be stored to correspond individually to a plurality of kinds of remote control devices. As a result, the step of reading the image corresponding to a specific remote control device in accordance with the identification information of the remote control device can be easily executed as a step of specifying the image signals for displaying the operation screen.

Moreover, the screen to be actually displayed on the display may not be limited to the display elements of the operation screen. For example, a screen displaying television broadcasting may be displayed simultaneously with the display elements of the operation screen. In this case, the image signal outputting step may output the image signals, which are synthesized from the image signals for displaying the operation screen and other image signals (for example, the image signals for displaying the television broadcasting).

As a preferable mode, there can be adopted the construction, in which the step of specifying the image signals has a step of selecting the display elements constructing the operation screen in accordance with the attributes. As a preferable mode, moreover, there can be adopted the construction, in which the step of specifying the image signals has a step of selecting one of a plurality of image signals for displaying a plurality of operation screens individually. As a preferable mode, there can be adopted the construction, in which the step of specifying the image signals has a step of evaluating a degree of suitability between the remote control device and each of forms of a plurality of operation screens based on the attributes of the remote control device. As preferable mode, each of forms which can be display by the display apparatus can be used as each of forms of a plurality of operation screens which is evaluate.

As a preferable mode, there can be adopted the construction, in which the step of specifying the image signals is performed according to the identification information for identifying the remote control device from another remote control device.

As a preferable mode, moreover, there can be adopted the construction, in which the step of specifying the image signals has a step of reading the attributes of a plurality of remote control device from storage device storing the attributes. The storage device can be exemplified by a semiconductor memory or a hard disk device.

As a preferable mode, moreover, there can be adopted the construction, in which the step of specifying the image signals has a step of reading at least any of display elements constructing the operation screen, an image containing a plurality of display elements and the layout information of the display elements from the storage device. As a preferable mode, moreover, there can be adopted the construction, in which the step of specifying the image signals has: a step of reading a plurality of attributes of the remote control device from storage device storing the attribute; and a step of reading either the display elements to construct the operation screen in accordance with the read attributes or an image containing a plurality of display elements, from the storage device. There can be preferably adopted the construction for preparing a

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remote control database, which is stored with the attributes of the remote control device, and a database, which is stored with: a display element; an image containing a plurality of display elements; a layout of display elements; and/or an operation method of the operation device corresponding to the display element.

As a preferable mode, moreover, there can be adopted the construction having a step of updating the database, which is stored with the attributes of the remote control device. As a preferable mode, moreover, there can be adopted the construction, which has a step of receiving signals outputted from the remote control device and a step of updating in case the attributes of the remote control device cannot be specified from the signals outputted from the remote control device. Specifically, the updating step can be performed by a step of inquiring an inquirer, and a step of registering the database with the attribute information sent in response to an inquiry.

As a preferable mode, moreover, there can be adopted the construction, which has a step of receiving signals outputted by the remote control device, and in which the image signal specifying step is a step for specifying the image signals in accordance with the attributes to be specified with the signals outputted from the remote control device.

As a preferable mode of a control program of an operation screen, on the other hand, there can be adopted the construction, which has a step of specifying image signals for displaying an operation screen, in accordance with the attributes of a remote control device, and a step of outputting the image signals.

First Embodiment

The aforementioned mode of embodiment will be described in connection with its more detailed example. FIG. 1 shows a construction of a display device according to a first embodiment of the invention, and FIG. 2 shows a flow chart of a control procedure according to the first embodiment.

As shown in FIG. 1, a digital television receiver 10 acting as the display device is provided with a reception device 12 for discriminating the signals of a plurality of remote control devices 30 and 301. The first embodiment will be described by assuming the state, in which the user uses the remote control device 30 of the remote control devices 30 and 301.

The digital television receiver 10 is provided with an execution unit 201 for executing the steps of FIG. 10. The execution unit 201 is provided with: a system software 14 or a storage device such as a flash memory, which is stored with a program for executing the operations of Step 1001 and Step 1002; and a GUI setting unit 20 or a circuit for executing the program.

At Step 2001 of FIG. 2, moreover, the execution unit 201 extracts (at Step 2002 of FIG. 2) the identification code of the remote control device 30 from the signals outputted from the remote control device 30 and received by the reception device 21. This identification code contains the maker and the model name or type number of the remote control device 30. There can be adopted the mode, in which the execution unit 201 reads the signals for displaying the image of the remote control device 30 on the basis of the identification code and outputs the signals read from a storage device 204 constituted by a flash memory or the like as the image signals for forming the operation screen. As a result, the image of the remote control device 30 is displayed in the display unit of a display device 22.

In the first embodiment, however, the following construction is adopted to display the operation screen more softly.

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Specifically, the execution unit 201 retrieves a remote control database 16 stored with the attributes of the remote control device on the basis of the identification code, and reads the attributes of the remote control device 30 used (Step 2003 in FIG. 2). Here, the attributes thus read are the pieces of information (that is, the presences or absences and functions of the button, the pointing device, the dial device and the display) on the arrangement of the operation devices owned by the remote control device. The remote control database 16 is constructed in a storage device 202 such as a flash memory.

FIG. 3 shows one example of the data stored in the remote control database 16. The data specify not only the presences or absences of the operation devices but also the designations of the operation devices, which are close to the fingers of the user holding the remote control device, and the device group. In FIG. 3, symbols "○" or "◎" indicate that the remote control device has the operation device, as indicated. Especially, the symbol "◎" indicates that the operation device is disposed at such a position as can be easily operated when the remote control device is held in an ordinary manner. On the other hand, a symbol "x" indicates the remote control device lacks in the operation device.

On the basis of the arrangement information obtained from the database 16, moreover, the execution unit 201 retrieves a layout/operation definition database 18, and reads out the definitions of the GUI parts suited for the remote control device 30 used, and their layout information and operation methods. For example, the operation screen displaying the read GUI parts, the remote control device 30 based on the layout information, and the operation device disposed in the remote control device 30 can be constructed and displayed.

However, the first embodiment is constructed to display not the operation screen indicating the mode of the remote control device 30 itself but the operation screen of a specific form. Specifically, a plurality of forms such as a form A, a form B and a form C are individually preset so that any of the operation screens of the forms may be selectively displayed. The individual forms can adopt the hierarchical menu type, the tab menu type and the pull-down menu type, for example. Here, the individual forms have different necessities for the operation devices of the individual remote control devices.

Specifically in the form A, for example: the pointing device is necessary; the ten key or the liquid crystal touch panel is unnecessary; and it does not matter (or it is redundant) whether or not the dial device is provided. In the form B: the pointing device and the ten key are necessary; the liquid crystal touch panel is unnecessary; and it does not matter (or it is redundant) whether or not the dial device is provided. In the form C: the liquid crystal touch panel and the ten key are necessary; but the pointing device and the dial device are unnecessary. Here: the necessary case is set with a numerical value 3 as the degree of necessity; the unnecessary case is set with a numerical value 0 as the degree of necessity; and the redundant case is set with a numerical value 1 as the degree of necessity. In the attributes of the remote control device, on the other hand: the presence/absence information on a predetermined operation device is set with 3 in case the operation device is disposed at the easily used position (corresponding to the symbol "◎" of FIG. 3); the presence/absence information on a predetermined operation device is set with 1 in case the operation device is present but not disposed at the easily used position (corresponding to the symbol "○" of FIG. 3); and the presence/absence information on a predetermined operation device is set with 0 in case the operation device is absent (corresponding to the symbol "x" of FIG. 3).

On the basis of the attributes of the remote control device 30 read from the remote control database, moreover, the

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execution unit 201 integrates the pieces of presence/absence information and the necessities of the individual operation devices, and totals the results of the individual operation devices. FIG. 4 shows an example of these integrating and totaling operations.

In this example, as shown in FIG. 4, the operations are executed on a remote control device a and a form A, in which the pointing device is disposed at an easily operated position, in which the ten key and the dial device are disposed not at the easily operated position, and in which the liquid crystal touch panel is not disposed. Specifically in FIG. 4, conformances of the form A and the remote control device a are the degree of necessity of the pointing device×the presence/absence information of the pointing device+the degree of necessity of the ten key×the presence/absence information of the ten key+the degree of necessity of the liquid crystal touch panel×the presence/absence information of the liquid crystal touch panel+the degree of necessity of the dial device×the presence/absence information of the dial device=3×3+0×1+0×0+1×1=10. At Step 2004 shown in FIG. 2, moreover, the operations of those conformances are executed for the individual forms. After this, the routine advances to Step 2005 shown in FIG. 2, at which the form is specified to have the highest value of the conformances of the individual forms. As a result, at Step 2006 shown in FIG. 2, the operation screen of the form of the highest conformance, that is, the form having the conformance to the remote control device 30 is specified and assembled. The operations of Step 2001 to Step 2006 thus far described construct those of Step 1001 of FIG. 10. As an other preferable mode, other method of evaluating a degree of suitability between the remote control device and each of forms of a plurality of operation screens based on the attributes of the remote control device can be adopted.

After this, the routine transfers to Step 2007 shown in FIG. 2, the operation screen thus assembled is outputted as the image signals for displaying in the display device 22.

Here, the definitions of the layout and the operation methods of the GUI parts include the arrangement rules of the GUI parts and the focus movement rules by the operations of the remote control device. The definitions contain the procedures to read the set of the GUI parts and to make it into the operation panel to be displayed in the display device 22. At Step 2008 shown in FIG. 2, the operation panel or the operation screen is displayed at a predetermined position of the display device 22 on the basis of the image signals produced by those procedures.

In the environment for the user to select a favorite remote control device, a controlled device can provide the layout and the operation methods of the GUI parts suited for the remote control device, without being followed by any explicit operation of the user. Moreover, the display contents need not be changed on the change in the layout and the operation methods of the GUI parts.

Here has been described the construction for displaying the operation screen of the most conformable form. However, the construction may also be made for the user to select the operation screen. FIG. 5 shows an example of the screen presenting a plurality of operation screens as selection branches for the user. FIG. 6 shows a flow chart of the works for the user to change the layout and the operation methods of the GUI parts. Here is shown an example, in which the operation screen is constructed according to a predetermined layout of the GUI parts. Therefore, the operation screen can be changed by changing the layout of the GUI parts.

When the layout and the operation methods of the GUI parts are to be changed, the execution unit 201 executes the aforementioned conformance decisions on the definitions of

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the GUI layout and the operation methods stored in the layout/operation definition database 18. At Step 603, the conformances are decided to the remote control device being used by the user having demanded the change. Prior to this conformance decision, the identification code of the remote control device is extracted from the signals outputted from the remote control device in Step 602. This embodiment is assumed that the change in the form of the operation screen is demanded at Step 601 prior to Step 602 by the user operating a specific operation device of the remote control device.

In a form changing screen 40, moreover, the results of the conformance decisions are arrayed and displayed sequentially in the order from the display form of the operation screen of the higher conformance. The form having a minus conformance, that is, the form, that is, the definitions of the layout and the operation methods of the GUI parts unavailable to the user with the device construction of the remote control device used is not displayed in the form changing screen 40.

In the form changing screen 40, an icon 42 indicating a form recommended for the remote control device being used is displayed in addition to one having a value exceeding a conformance obtained from the result of the conformance decision.

Thus, the user can select an operation screen of a favorite form in the environment where the user can select the favorite remote control device. The using conveniences can be further improved by making unselectable the form, which cannot be used by the remote control device selected by the user.

Second Embodiment

A second embodiment of the invention will be described with reference to the accompanying drawings. FIG. 7 shows a schematic construction block diagram of a display device according to the second embodiment of the invention. In the second embodiment, when a remote control device not registered in the remote control database is used, the outside can be inquired of the arrangement information on the remote control device, and the arrangement information can be added to the remote control database. FIG. 8 shows a flow chart of a routine for registering the remote control database additionally with the arrangement information of the remote control device.

A digital television receiver 110 according to the second embodiment is different from that of the first embodiment in that it is provided with an external input/output device 117 and in that it has a function to inquire the outside of the attributes of the remote control device by using the external input/output device 117. This function can be executed by the program stored as the system software 14.

At first Step 801, the execution unit 201 reads the identification code of a remote control device 130 from the received signals transmitted from the remote control device 130. The execution unit 201 retrieves the remote control database 16 on the basis of the read identification code. In case the retrieval finds that the database 16 is not registered with the arrangement information on the remote control device 130 used, the routine transfers to Step 802, at which the outside is inquired of the arrangement information of the remote control device 130 by the external input/output device 117 of the execution unit 201.

At Step 803, on the other hand, the attributes of the remote control device 130 can be distributed under the environment where the remote control device 130 was manufactured. In response to the inquiry (or demand) at Step 802, therefore, the attributes of the remote control device 130 are distributed

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from the distributor at Step 804. In response to the distribution of the attributes, at Step 805 the execution unit 201 registers the remote control database 16 with the arrangement information obtained from the outside together with the identification information of the remote control device. On the basis of the arrangement information, moreover, the layout/operation definition database 18 is retrieved to read out the display form (that is, the definitions of the layout and the operation method of the GUI parts in the second embodiment) suited for the remote control device 130 used. Like the first embodiment, proper one is selected at Step 806 from the layout and operation method of the GUI parts stored in the layout/operation definition database 18 in accordance with the arrangement information of the remote control device 130.

Moreover, the GUI setting unit 20 of the execution unit 201 outputs the image signals for displaying the operation screen of the highest conformance to the display device 22. Specifically in the GUI setting unit 20, the layout and the operation methods of the GUI parts and the set of the GUI parts specifying the inclusion relations or the display contents are defined separately of each other on the GUI to be used in the display device 22.

FIG. 9 shows one example of the transfer route of the arrangement information of the remote control device 130 from the outside to the television receiver 110. In case an unknown remote control device is detected, as shown in FIG. 9, the receiver 110 transmits the code of the maker/model contained in the remote control signals, from the remote control device to a manufacturer 140 of the receiver 110, and executes the inquiry. The television manufacturer 140 having received the inquiry transmits the arrangement information of the remote control device corresponding to the maker/model code inquired, to the television receiver 110 via a wide area network such as the telephone lines, the internet or a broadcasting station 142.

When at least the remote control device corresponding to the television receiver 110 is shipped to the market, the television manufacturer 140 distributes the definition information of the remote control device in advance to the television receiver 110 through the digital broadcasting station 142 thereby to update the remote control database 116 of the television receiver 110 of the user. As a result, it is possible to suppress the occurrence of the unknown remote control device as much as possible.

In the environment where the user can select the remote control device, as has been described hereinbefore, there can be provided an environment where a new remote control device corresponding to the television receiver of the user can be properly used at all times when it is manufactured.

What is claimed is:

1. A controlling method of an operation screen for operations of a remote control device, comprising the steps of:
 - acquiring an attribute of a remote control device;
 - determining an operation form corresponding to the remote control device from among a plurality of operation forms previously stored based on the acquired attribute of the remote control device; and
 - displaying an operation screen related to the determined operation form displayed,
- wherein, in the step of determining the operation form, the operation form corresponding to the remote control device is determined by evaluating a degree of suitability between the remote control device and each of the plurality of operation forms based on the acquired attribute of the remote control device.
2. A controlling method according to claim 1, wherein the plurality of operation forms are different from each other in a

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combination of operation devices selected for use therein from among a plurality of operation devices.

3. A controlling method according to claim 2, wherein the plurality of operation devices includes at least one device of a pointing device, a key device, a touch panel device and a dial device.

4. A controlling method according to claim 1, wherein the plurality of operation forms are different from each other in a layout of a display element constructing the operation screen.

5. A controlling method according to claim 1, further comprising a step of, in case that the acquired attribute of the remote control device cannot be specified, acquiring an attribute of the remote control device from outside, and updating a database in which attributes of remote control devices are previously stored.

6. A computer-readable medium in which a program is stored, the program making a computer execute the controlling method according to claim 1.

7. A display controlling apparatus for making an operation screen for operations of a remote control device displayed in a display unit, the apparatus comprising:

an acquiring unit which acquires an attribute of a remote control device;

a determining unit which determines an operation form corresponding to the remote control device from among a plurality of operation forms previously stored in a storing unit based on the attribute of the remote control device acquired by the acquiring unit; and

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a controlling unit which displays an operation screen related to the operation form which is determined by the determining unit displayed.

wherein the determining unit determines the operation form corresponding to the remote control device by evaluating a degree of suitability between the remote control device and each of the plurality of operation forms based on the attribute of the remote control device acquired by the acquiring unit.

8. A display controlling apparatus according to claim 7, wherein the plurality of operation forms are different from each other in a combination of operation devices selected for use therein from among a plurality of operation devices.

9. A display controlling apparatus according to claim 8, wherein the plurality of operation devices include at least one device of a pointing device, a key device, a touch panel device and a dial device.

10. A display controlling apparatus according to claim 7, wherein the plurality of operation forms are different from each other in a layout of a display element constructing the operation screen.

11. A display controlling apparatus according to claim 7, further comprising a unit which, in case that the attribute of the remote control device acquired by the acquiring unit cannot be specified, acquires an attribute of the remote control device from outside, and updates a database in which attributes of remote control devices are previously stored.

* * * * *



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Mizutome et al.

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(45) **Date of Patent:** Oct. 5, 2010

(54) **METHOD AND APPARATUS OF POWER MANAGEMENT FOR MOVING IMAGE-STREAMING CONTENT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1382 days.

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(21) Appl. No.: **10/671,741**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
H04N 7/173 (2006.01)

(52) **U.S. Cl.** **725/134; 709/227; 348/731**

(58) **Field of Classification Search** 348/731.
348/725; 725/139, 146, 148, 32, 34, 134;
709/227, 229; 455/343, 574

See application file for complete search history.

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(57) **ABSTRACT**

Provided is a receiving apparatus for receiving streaming contents which is capable of receiving contents at a higher speed. The receiving apparatus receives and accumulates the streaming contents periodically during a power off state or while other contents are being audiovisually enjoyed.

8 Claims, 12 Drawing Sheets

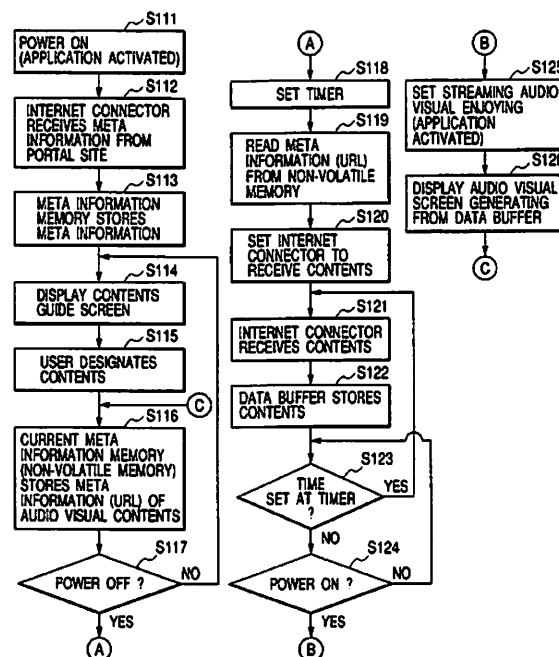


FIG. 1A

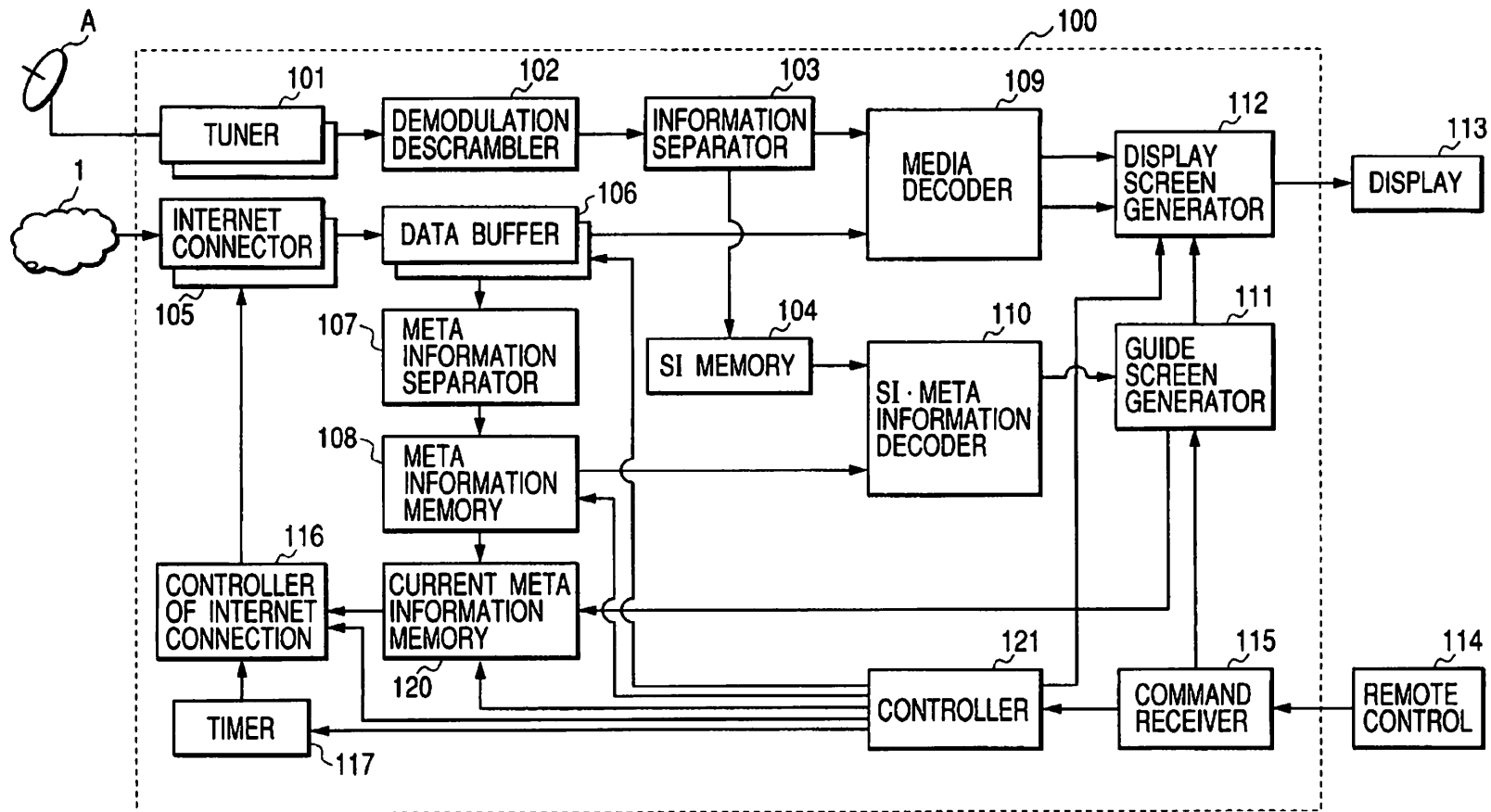
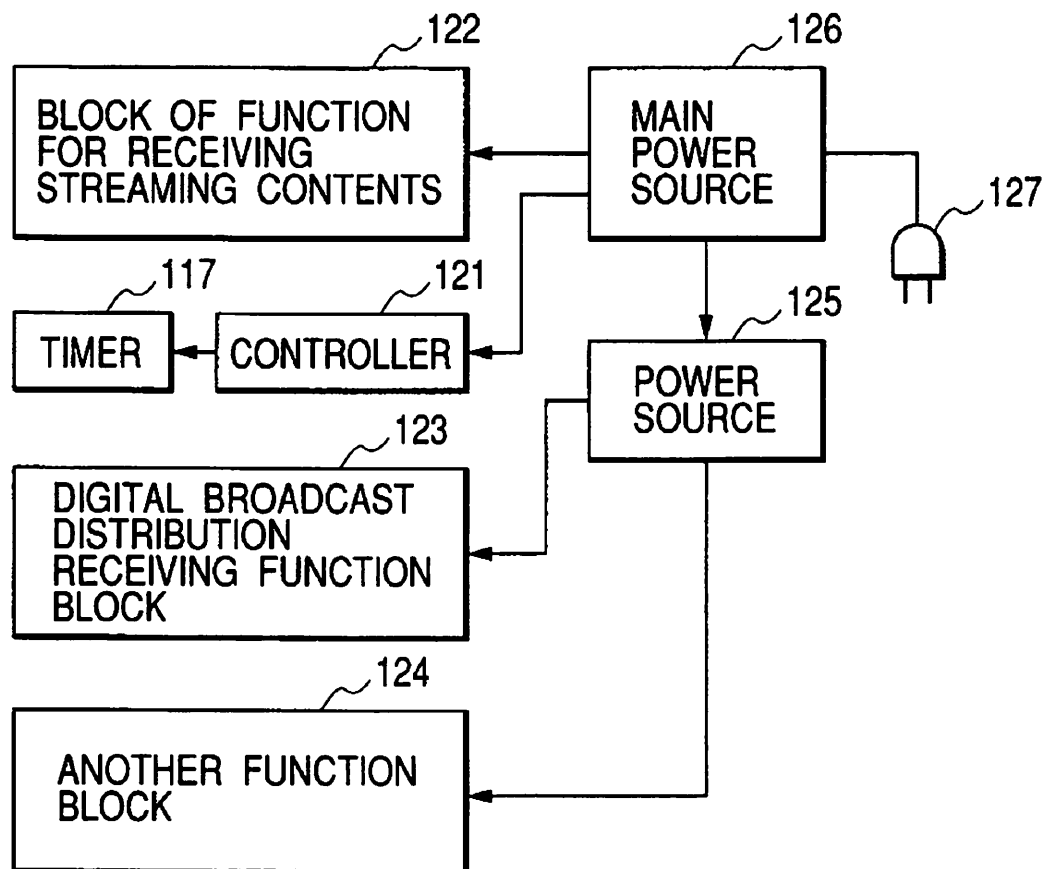


FIG. 1B

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FIG. 2

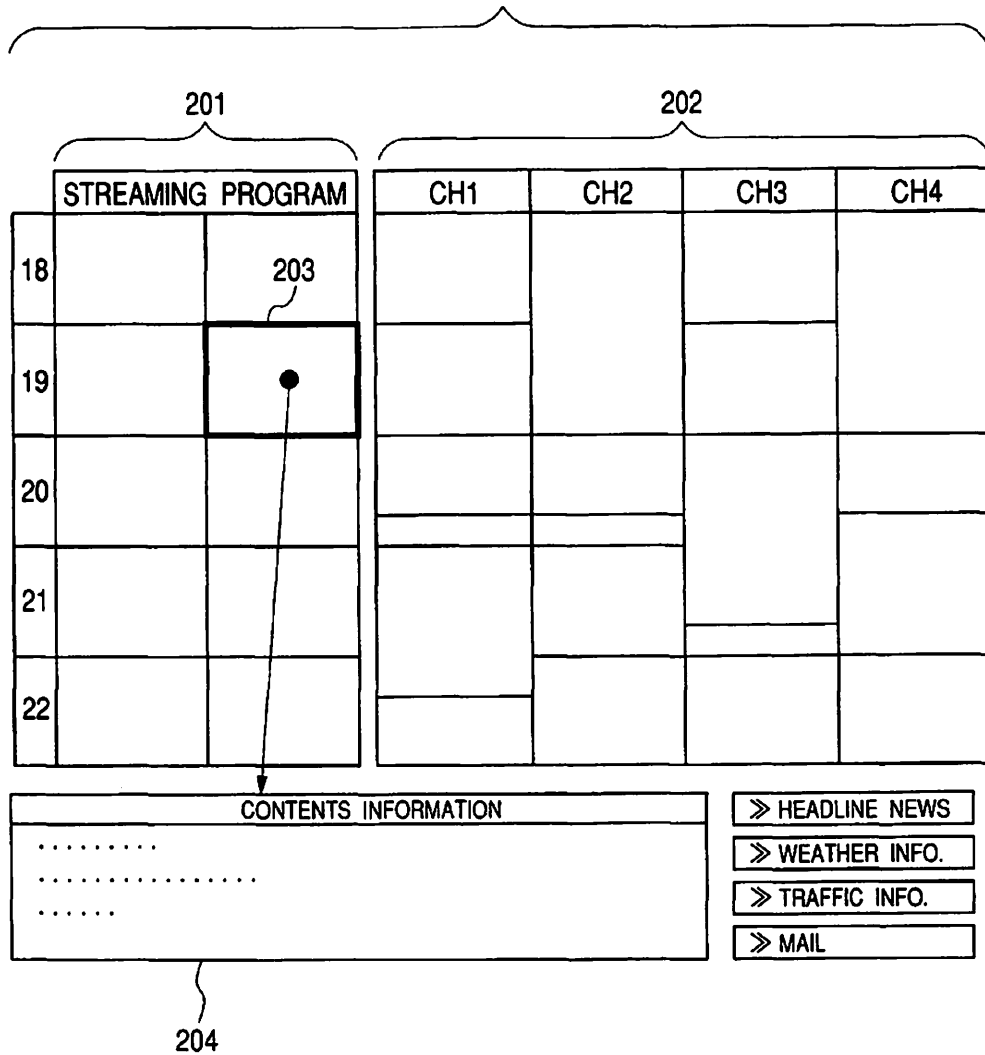


FIG. 3

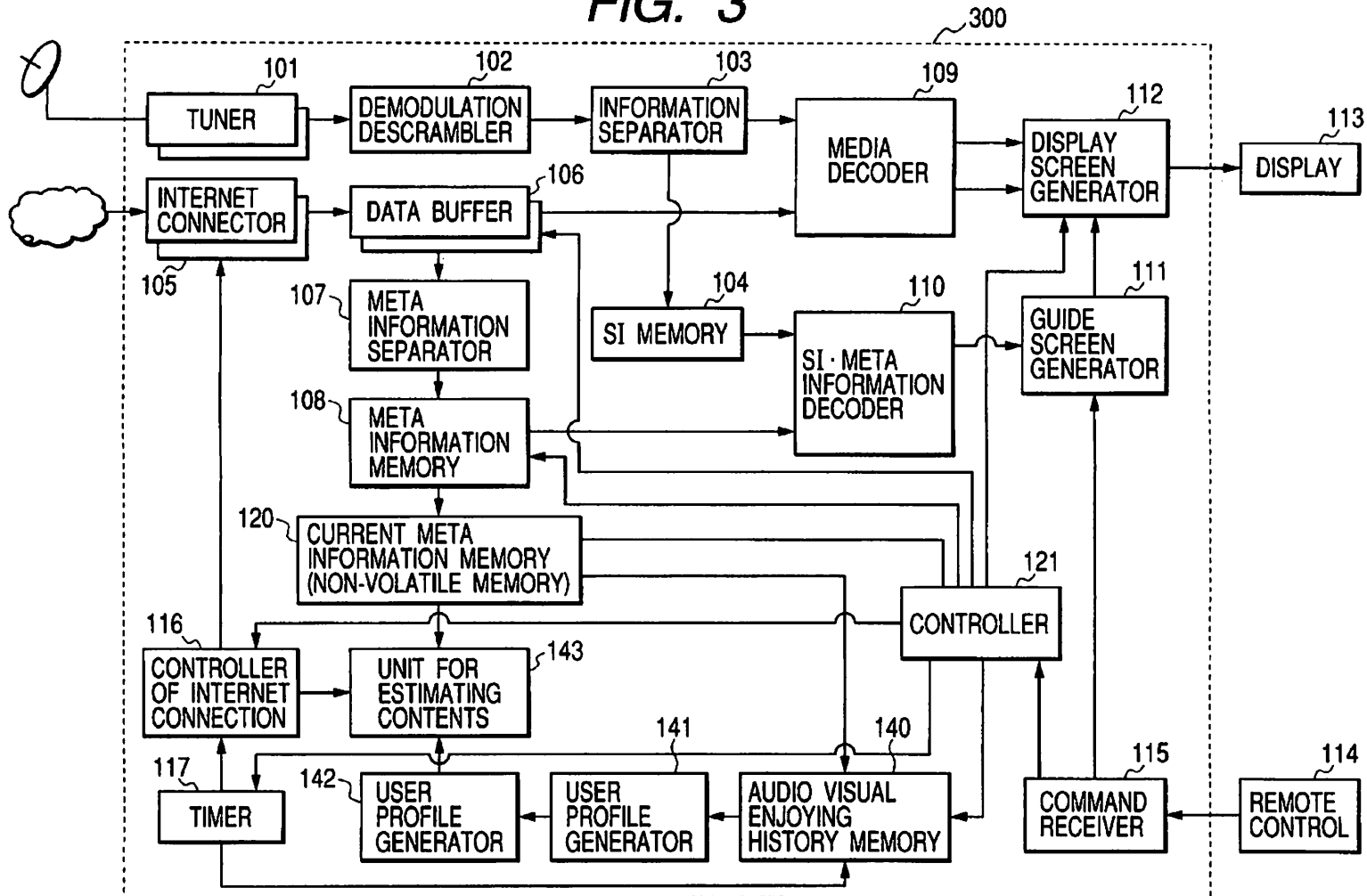
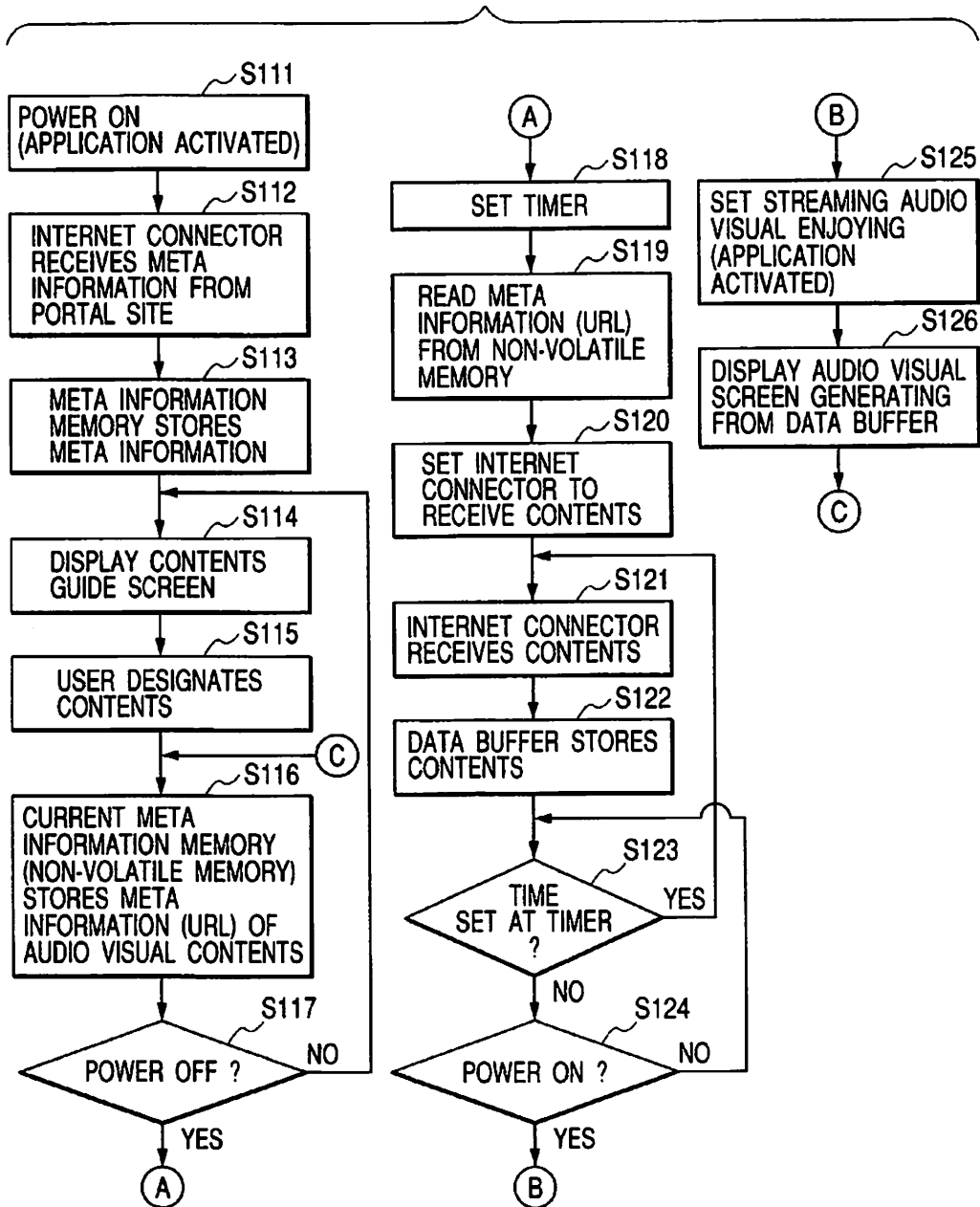


FIG. 4

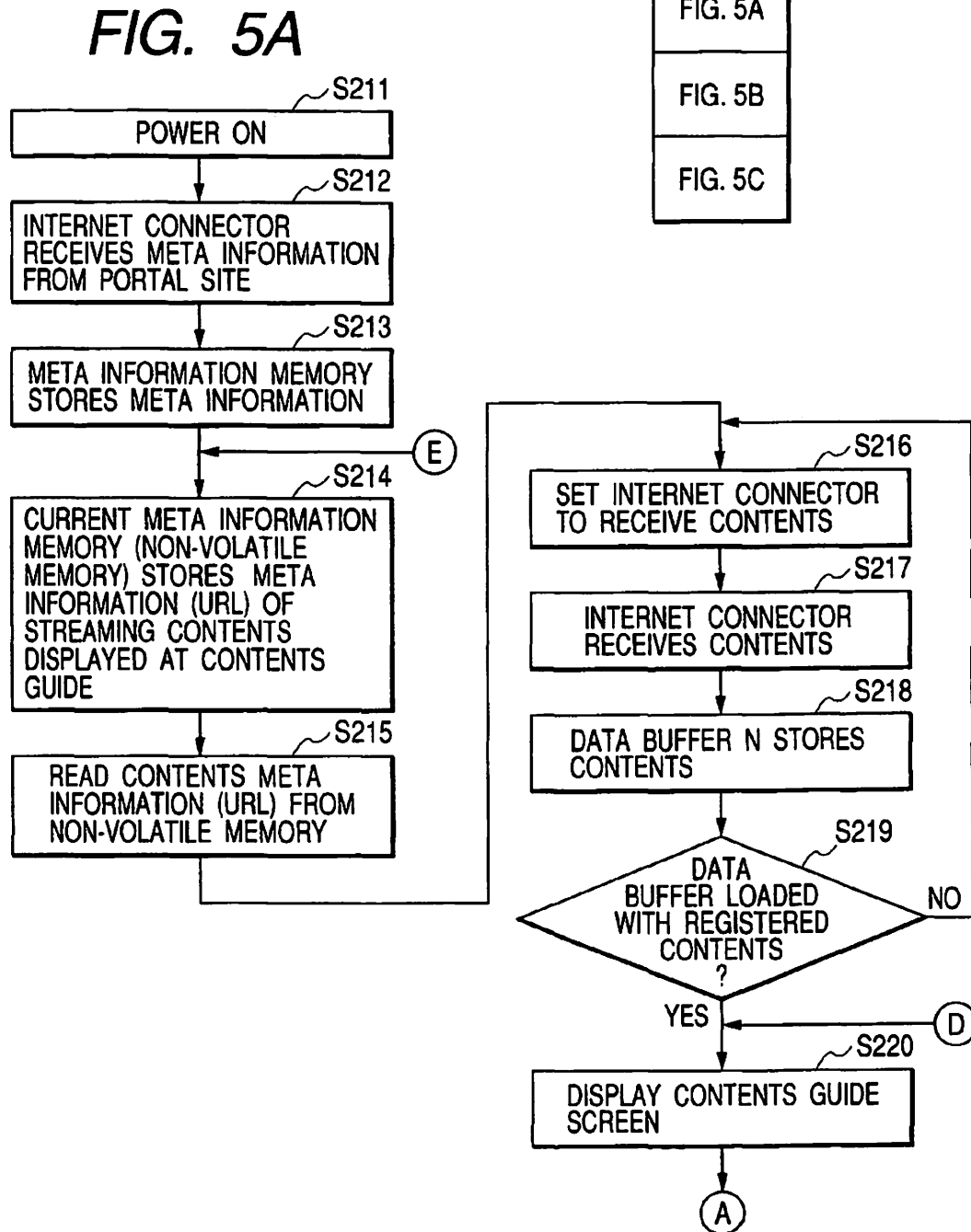


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FIG. 5

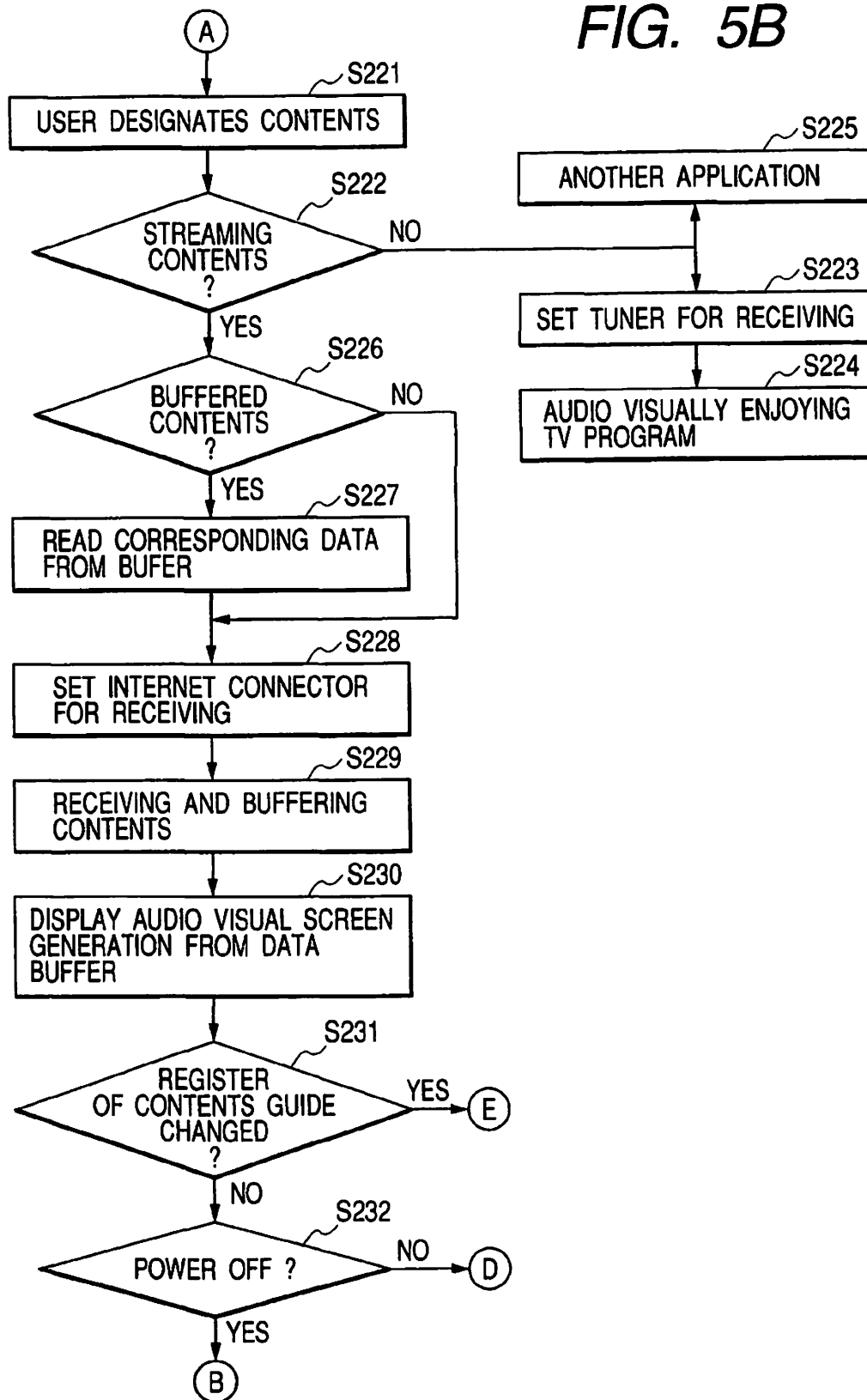
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FIG. 5B



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FIG. 5C

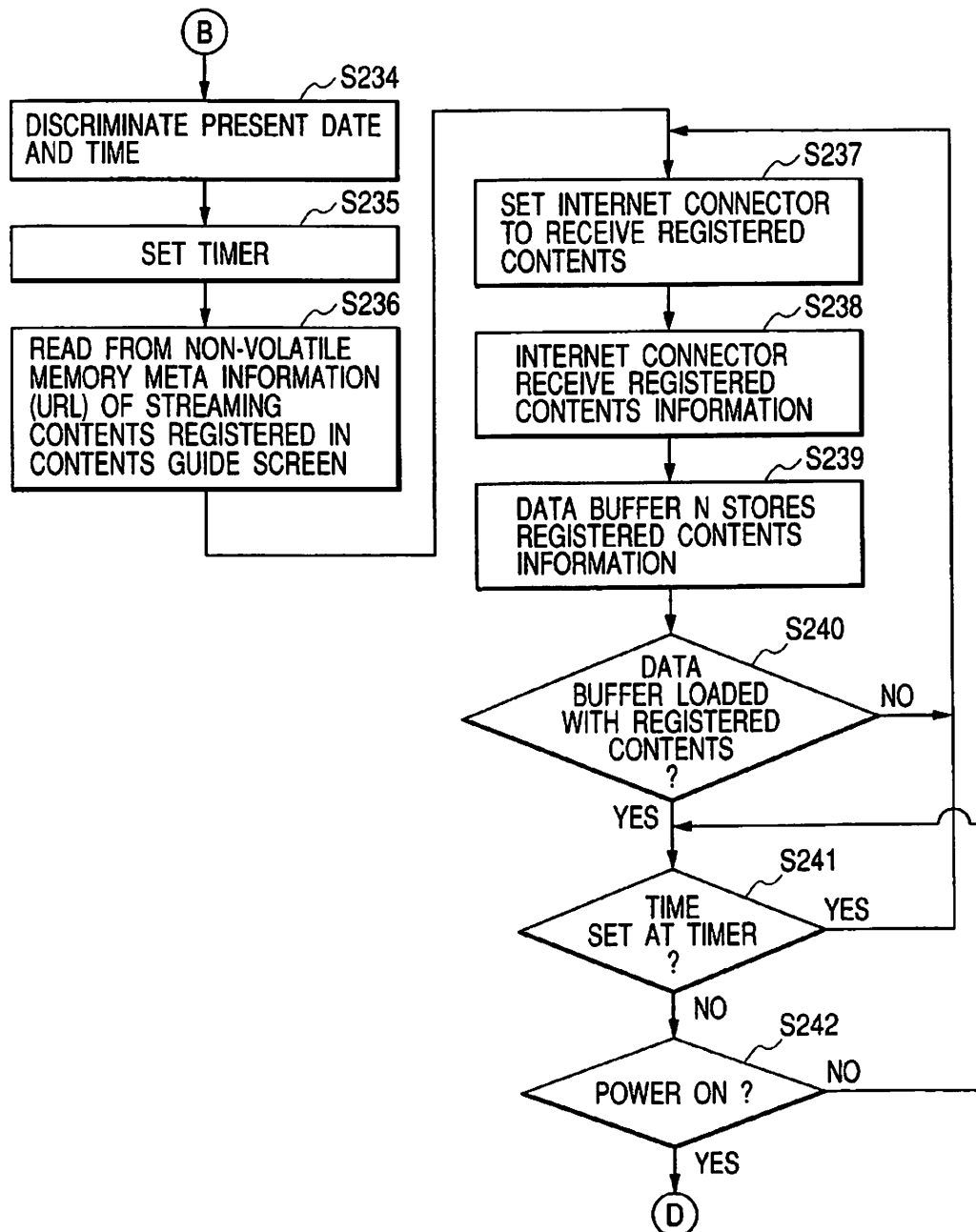
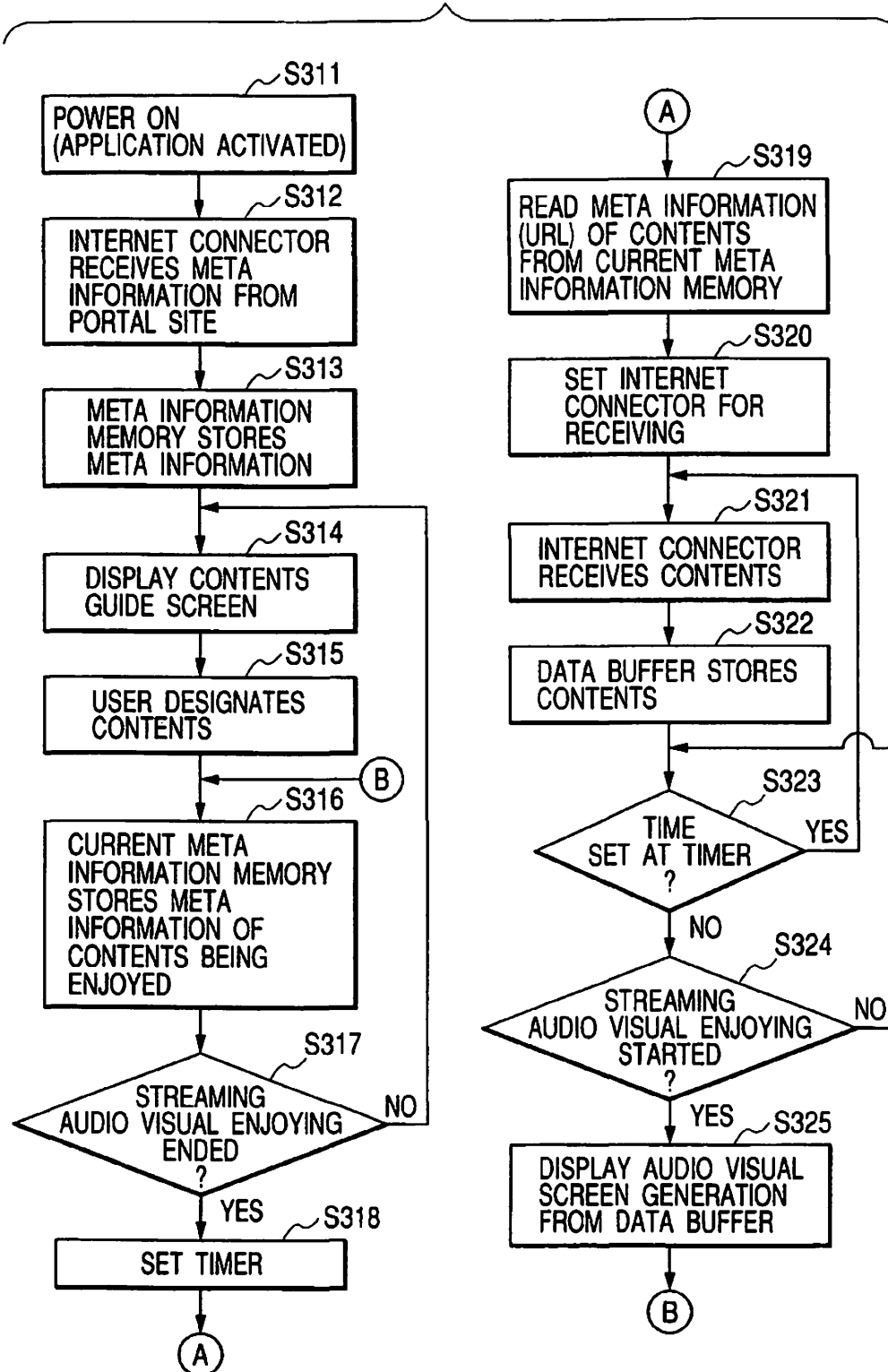


FIG. 6



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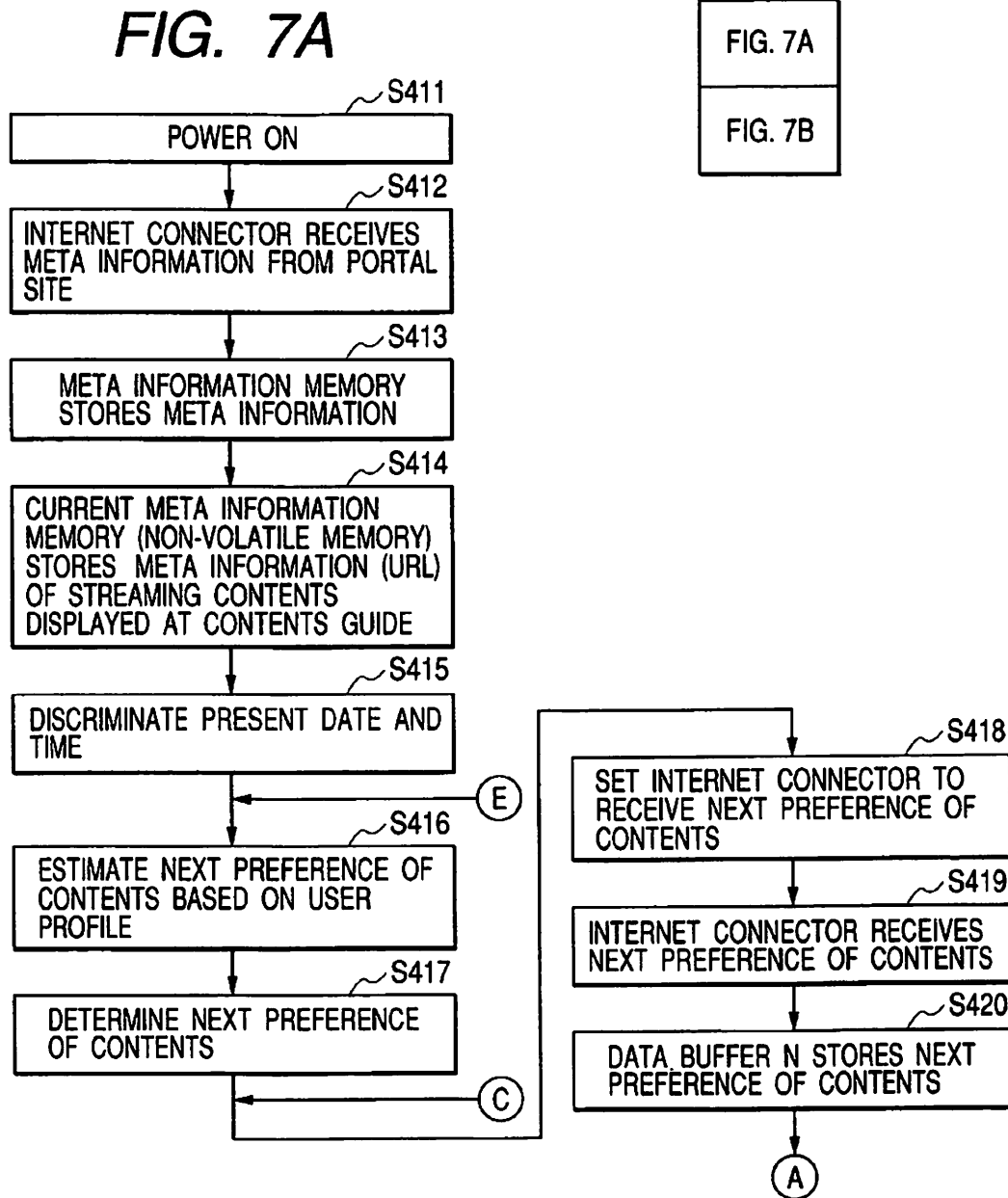
FIG. 7

FIG. 7B

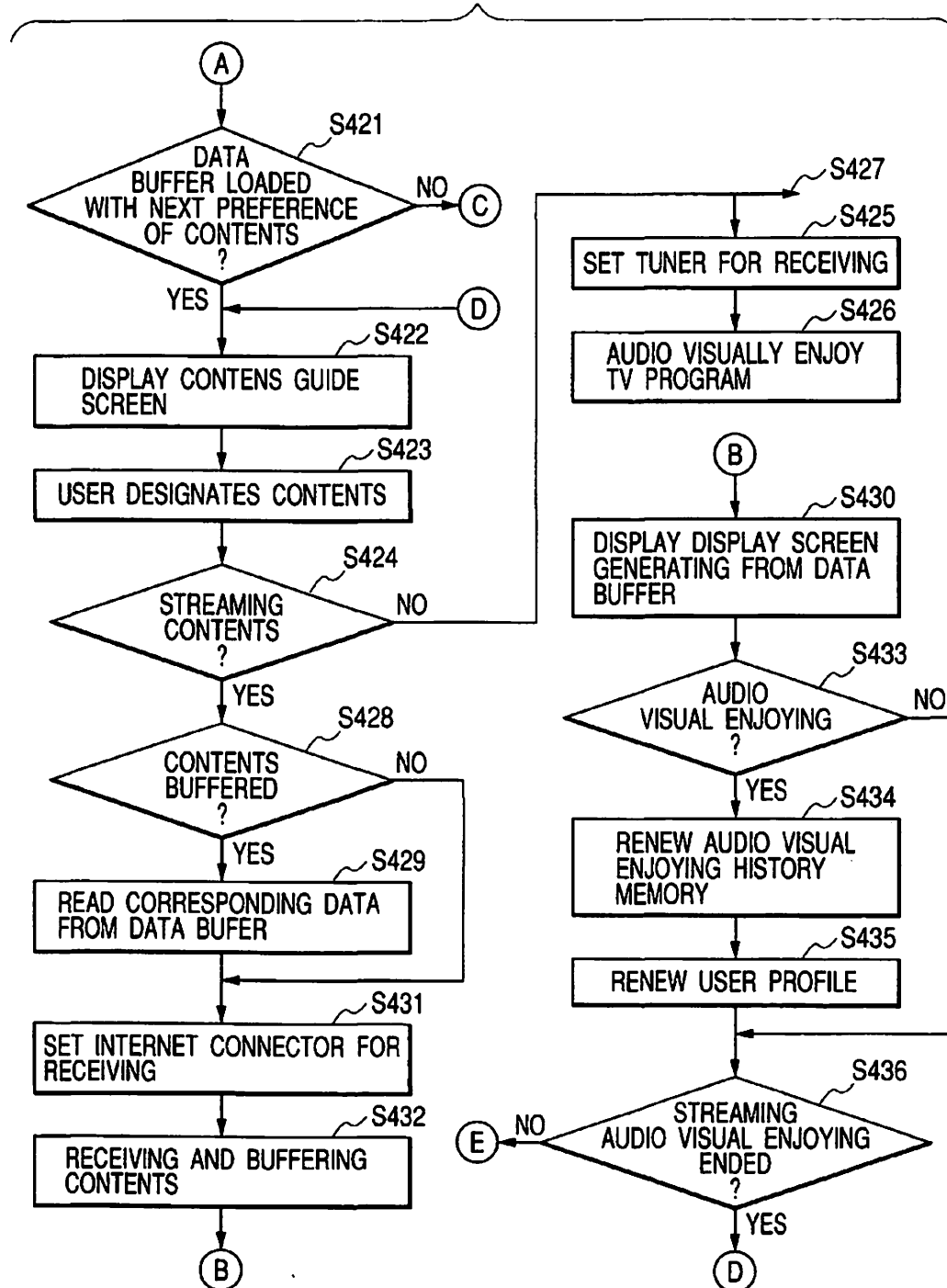


FIG. 8

out_URL	CRID	Cat	Date	Day	Time	Date_Stamp	Reo	Freq
http://ServerA/ ../filename1.xxx	AAA/Sport	2	-1	6	19	20010428	0	10
http://ServerB/ ../filename19.yyy	BBB/Sport	2	-1	1	20	20010422	1	5
http://ServerE/ ../filename5	EEE/Variety	4	-1	3	22	20010425	0	2
http://ServerA/ ../filename9	AAA/Quiz	12	-1	3	23	20010502	0	8
http://ServerG/ ../filename24	GGG/News	1	-1	-1	07	20010428	0	20
http://ServerK/ ../filename28	KKK/TalkShow	20	-1	4	13	20010503	0	2
http://ServerA/ ../filename5	AAA/Drama	16	-1	6	22	20010505	0	4
http://ServerC/ ../filename3	CCC/Drama	16	-1	7	09	20010429	1	2
.....								
.....								

cnt_URL URL OF AUDIO VISUALLY ENJOYED CONTENTS
 CRID ID OF AUDIO VISUALLY ENJOYED CONTENTS
 Cat ID CATEGORIES OF CONTENTS ENJOYED (NEWS: 1, SPORTS: 2, DRAMA: 16, ...)
 Date DATES [1-31]
 Day A DAY OF WEEK [1-7 1: MON, 2: TUE,, 7: SUN]
 Time TIME [0-23]
 Date_Stamp RENEWAL DATE [yyyy/mm/dd]
 Rec RECORD [0: PLAY, 1: RECORD]
 Freq FREQUENCY [xx TIMES]

REFERENCE: rtsp://realserver/media/video1.rm (IN CASE OF RealServer)
 mms://nsserver/content/video1.asf (IN CASE OF Windows Media Server)

.xxx/.yyy: EXTENSION OF STREAMING CONTENTS
 e.g. .asf: Windows Media FILE, rm: Real Video FILE etc.

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METHOD AND APPARATUS OF POWER MANAGEMENT FOR MOVING IMAGE-STREAMING CONTENT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a receiving apparatus, and particularly to an apparatus for receiving a streaming broadcast.

2. Related Background Art

In recent years, information is distributed to individual households through various media. For example, television broadcasts, radio broadcasts, data broadcasts, etc. are distributed by means of ground waves as broadcast waves, satellites, etc. In addition, distribution services for images, audio, information, etc. are provided by means of the Internet, electronic mails, etc. through communication lines.

A conventional broadcast system is currently being shifted to a digital broadcast system in which television signals are transmitted as digital signals. The shift to the digital broadcast system is underway to enhance image quality and to increase the number of channels by utilizing digital transmission and coding technologies.

On the other hand, a communication system is benefiting from recent progresses of the digital coding technologies related to image and audio data, and from improved network environments (including broadband). As a result, it is becoming widespread to use the Internet to provide a distribution of moving images comparable in quality to that of the television broadcast, that is, a distribution of streaming contents (hereinafter, referred to as "streaming broadcast").

The streaming broadcast includes the term "broadcast", but is largely different in arrangement from the conventional television broadcast (of a push type) in the first place. In other words, while the distribution of the images and audio is similarly performed by means of the communication lines such as the Internet through, the streaming broadcast requires a user to access and obtain desired streaming contents (which is called a pull type). Unlike general television broadcast receiving, the streaming broadcast is not received immediately after calling up a desired channel.

Currently, the streaming broadcast is received (utilized) using a personal computer (hereinafter, referred to as "PC") in most cases, and generally requires the following procedure.

A user who wishes to audiovisually enjoy the streaming broadcast must first find out desired contents (a desired streaming broadcast program) from among many streaming contents scattered throughout the Internet. For that purpose, the user activates an Internet browser, and then visits a portal site related to the streaming broadcast or searches through Websites by using a search engine or the like. Thus, the user finds out information on the desired streaming contents.

By the above operations, the user obtains information related to the desired streaming contents including program information such as a title, distribution information such as a start time, and address information such as a Uniform Resource Locator (hereinafter, referred to as "URL"). After that, the user accesses an address (URL) where the streaming contents exist to start to obtain the streaming contents. Concurrently, application software called a streaming player is activated, so that the streaming contents are audiovisually enjoyed (reproduced).

In the case of receiving the streaming contents, it is necessary to subject several to ten and several seconds of data to a buffering process before starting reproduction. The buffering process is performed as a requirement for decoding receive

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data on a terminal side, but mostly for mainly compensating uncertainty of speed on the Internet as a channel to perform smooth reproduction on the terminal side.

The above-mentioned type of receiving process for streaming contents is disclosed, for example, in JP 2001-359073 A.

As described above, the streaming broadcast is currently utilized by PC users in most cases. However, the present inventors presupposes that in the near future, while communication infrastructures are improved in the individual households, it becomes widespread to enjoy the streaming broadcast, as well as the conventional television broadcast, on television in living rooms.

In the above case, it is conceivable that it is demanded for a user to select and audiovisually enjoy a program (contents) of the streaming broadcast in such a manner as to feel as comfortable as in the conventional television broadcast.

The above-mentioned operation for audiovisually enjoying the streaming broadcast using a PC is the same as a conventional pull-type operation for obtaining information based on a demand (an instruction) of a user, such as an operation for browsing Websites or using electric mails. Therefore, a general PC user may feel no discomfort except that it is inconvenient to search for and audiovisually enjoy the streaming contents.

However, a general television audience is accustomed to watching television, that is, being able to audiovisually enjoy a desired program immediately after turning on a power and selecting a corresponding channel. Therefore, it is impractical for the television audience himself/herself to find out main data and a location (address (and a file name)) of streaming contents that he/she wishes to audiovisually enjoy, and to perform the pull-type operation for receiving distributed contents based on the found data. Thus, it is necessary to provide a form capable of selecting and audiovisually enjoying contents by a simpler method such that the audience feels as comfortable as when audiovisually enjoying a television program.

There is another problem described above in that unlike the general process for receiving the television broadcast, the receiving process for the streaming contents requires a time period of several to ten and several seconds at the time of switching the streaming contents which corresponds to the time of changing channels on television. Meanwhile, the user must wait for the same time period.

The above problem is caused by the time period for buffering described above, which equals to a total length of a time period required for buffering desired streaming contents in a distribution side server and a time period required for buffering a predetermined amount of the streaming contents on a receiving terminal side. Generally, the higher a data rate for contents is, the longer the buffering time period for the contents becomes.

Accordingly, it is impossible that the user selects the desired streaming contents in such a manner as to feel as comfortable as when switching channels on television.

SUMMARY OF THE INVENTION

The present invention therefore has an object to provide a receiving apparatus and a receiving method which are capable of receiving contents at a higher speed when receiving a streaming broadcast through a network.

Another object of the present invention is to provide a receiving apparatus and receiving method for receiving streaming contents through a network, the receiving apparatus and receiving method including:

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in response to an instruction of a power off, periodically receiving during the power off the streaming contents that are received immediately before the power off; and accumulating in accumulating means data of the streaming contents that are periodically received during the power off.

Further another object of the present invention is to provide a receiving apparatus and receiving method for receiving streaming contents through a network and outputting the streaming contents to a monitor device, the receiving apparatus and receiving method including:

in response to an instruction of a monitor stop for the streaming contents, periodically receiving during the monitor stop the streaming contents that are received immediately before the monitor stop; and accumulating in accumulating means data of the streaming contents that are periodically received during the monitor stop.

Still another object of the present invention is to provide a receiving apparatus and receiving method for receiving streaming contents through a network, the receiving apparatus and receiving method including:

based on predetermined guide information related to plural sets of the streaming contents, periodically receiving the plural sets of the streaming contents in parallel; and accumulating in accumulating means data of the plural sets of the streaming contents that are periodically received.

Yet still another object of the present invention is to provide a receiving apparatus and receiving method for receiving arbitrarily selected streaming contents through a network by receiving means, and outputting the received streaming contents to a monitor device in an audiovisually enjoyable form, the receiving apparatus and receiving method including:

estimating and determining a streaming contents preference to be selected from plural sets of the streaming contents based on a user profile;

periodically receiving the streaming contents preference determined, during a power off; and

accumulating in accumulating means data of the streaming contents preference that is periodically received.

Further, yet still another object of the present invention is to provide a receiving apparatus and receiving method for receiving arbitrarily selected streaming contents through a network by receiving means, and selectively outputting the received streaming contents and other contents to a monitor device in an audiovisually enjoyable form, the receiving apparatus and receiving method including:

estimating and determining a streaming contents preference to be selected from plural sets of the streaming contents based on a user profile;

periodically receiving the streaming contents preference determined during a period when the other contents are outputted to the monitor device; and

accumulating in accumulating means data of the streaming contents preference that is periodically received.

Further, yet still another object of the present invention is to provide a receiving apparatus and receiving method for receiving arbitrarily selected streaming contents through a network by receiving means, and outputting the received streaming contents to a monitor device in an audiovisually enjoyable form, the receiving apparatus and receiving method including:

estimating and determining a streaming contents preference to be selected from plural sets of the streaming contents based on a user profile;

in response to a power on, periodically receiving the streaming contents preference determined; and

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accumulating in accumulating means data of the streaming contents preference that is periodically received.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a block diagram showing a configuration of a receiving apparatus to which the present invention is applied;

FIG. 1B is a block diagram showing a power supply system used for the present invention;

FIG. 2 is a diagram showing an appearance of a contents guide screen;

FIG. 3 is a block diagram showing another configuration of a receiving apparatus to which the present invention is applied;

FIG. 4 is a flow chart showing a receiving operation;

FIG. 5 is comprised of FIGS. 5A, 5B and 5C are flow charts showing a receiving operation;

FIG. 6 is a flow chart showing a receiving operation;

FIG. 7 is comprised of FIGS. 7A and 7B are flow charts showing a receiving operation; and

FIG. 8 is a diagram showing user profile data.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to an embodiment mode of the present invention, a receiving apparatus includes:

receiving means for receiving streaming contents through a network;

power detecting means for detecting an instruction of a power off from operation instructing means;

controlling means for, in response to an output from the power detecting means indicating detection of the power off, controlling the receiving means to periodically receive during the power off the streaming contents that are received by the receiving means immediately before the power off; and

accumulating means for accumulating data of the streaming contents that are periodically received during the power off.

According to another embodiment mode of the present invention, a receiving apparatus includes:

receiving means for receiving streaming contents through a network;

outputting means for outputting the streaming contents to a monitor device;

detecting means for detecting an instruction of a monitor stop for the streaming contents;

controlling means for, in response to an output from the detecting means indicating detection of a monitor stop, controlling the receiving means to periodically receive during the monitor stop the streaming contents that are received by the receiving means immediately before the monitor stop; and

accumulating means for accumulating data of the streaming contents that are periodically received during the monitor stop.

According to further another embodiment mode of the present invention, a receiving apparatus includes:

receiving means for receiving streaming contents through a network;

controlling means for, based on predetermined guide information related to plural sets of the streaming contents, controlling the receiving means to periodically receive the plural sets of the streaming contents in parallel; and

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accumulating means for accumulating data of the plural sets of the streaming contents that are periodically received.

According to still another embodiment mode of the present invention, a receiving apparatus, which receives arbitrarily selected streaming contents through a network by receiving means, and outputs the received streaming contents to a monitor device in an audiovisually enjoyable form, includes:

estimating means for estimating and determining a streaming contents preference to be selected from plural sets of the streaming contents based on a user profile;

controlling means for controlling the receiving means to periodically receive the streaming contents preference determined by the estimating means, during a power off; and

accumulating means for accumulating data of the streaming contents preference that is periodically received.

According to yet still another embodiment mode of the present invention, a receiving apparatus, which receives arbitrarily selected streaming contents through a network by receiving means, and selectively outputs the received streaming contents and other contents to a monitor device in an audiovisually enjoyable form, includes:

estimating means for estimating and determining a streaming contents preference to be selected from plural sets of the streaming contents based on a user profile;

controlling means for controlling the receiving means to periodically receive the streaming contents preference determined by the estimating means during a period when the other contents are outputted to the monitor device; and

accumulating means for accumulating data of the streaming contents preference that is periodically received.

Further, according to yet still another embodiment mode of the present invention, a receiving apparatus, which receives arbitrarily selected streaming contents through a network by receiving means, and outputs the received streaming contents to a monitor device in an audiovisually enjoyable form, includes:

estimating means for estimating and determining a streaming contents preference to be selected from plural sets of the streaming contents based on a user profile;

controlling means for, in response to a power on, controlling the receiving means to periodically receive the streaming contents preference determined by the estimating means; and

accumulating means for accumulating data of the streaming contents preference that is periodically received.

Embodiment 1

FIG. 1A is a block diagram showing a configuration of a receiving apparatus 100 according to this embodiment.

The receiving apparatus 100 shown in FIG. 1A is capable of receiving a television broadcast by broadcast waves and also a streaming broadcast distributed through the Internet. In addition to receiving a digital broadcast, the receiving apparatus 100 receives various images, video, and data through the Internet, and outputs to a display 113 a program, streaming contents, and Internet information (a Website, an electronic mail, etc.) which are selected by a user using a remote control 114.

The receiving apparatus 100 includes a tuner 101, a demodulation descrambler 102, an information separator 103, a service information (hereinafter, referred to as "SI") memory 104, an Internet connector 105, a data buffer 106, a metainformation separator 107, a metainformation memory

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108, a media decoder 109, an SI/metainformation decoder 110, a guide screen generator 111, a display screen generator 112, the display 113, the remote control 114, a command receiver 115, a controller of Internet connection 116, a timer 117, a current metainformation memory 120, and a controller 121.

In FIGS. 1A and 1B, the tuner 101, the demodulation descrambler 102, and the information separator 103 compose a digital broadcast distribution receiving function block 123 that is used when receiving a digital broadcast. The Internet connector 105, the data buffer 106, the metainformation separator 107, the metainformation memory 108, the controller of Internet connection 116, the current metainformation memory 120, and the like compose a streaming contents receiving function block 122 that is involved when receiving a streaming broadcast. The media decoder 109 and the SI/metainformation decoder 110 compose a function block (a kind of another function block 124) that is used for both a digital broadcast system and a streaming broadcast system. The guide screen generator 111, the display screen generator 112, and the like also compose a kind of another function block 124 for both systems. Here, the controller 121 controls an operation of a main power source 126 that is connected to a commercial power source (or battery) 127 and an operation of a power source 125.

The tuner 101 and the demodulation descrambler 102 receive a radio wave having a designated frequency from digital broadcast waves transmitted through an antenna A or a cable (not shown), perform processes such as demodulation, A/D conversion, error correction, and descrambling for limited reception if necessary, and generate a data row called a transport stream (TS).

The information separator 103 separates the generated transport stream into two groups: video information, audio information, and data broadcast information; and related information (such as PSI/SI) accompanying the above information, and sends the former group to the media decoder 109 and the latter group to the SI memory 104.

From among the information sent as the PSI/SI, the SI memory 104 stores information related to a transmission line of each channel (such as a modulation frequency) and information related to a broadcast program (such as a program title and a broadcast date and time) by associating one with another.

The media decoder 109 decodes the video information, audio information, and data broadcast information sent from the information separator 103, and sends the respective information as display data to the display screen generator 112. The media decoder 109 has a function for decoding streaming contents received through the Internet described later in addition to decoding audiovisual data in an MPEG-2 format widely adopted in the digital broadcast.

The SI/metainformation decoder 110 decodes SI information in the digital broadcast system inputted from the SI memory 104, and metainformation (additional information and attribute information) of the streaming contents inputted from the metainformation memory 108, according to their corresponding coding systems, and sends the respective information to the guide screen generator 111.

The guide screen generator 111 generates a guide screen for selecting a television program and streaming contents based on the related information of television programs and streaming contents which are decoded in the SI/metainformation decoder 110. According to this embodiment, in order to seamlessly provide a user with television broadcast programs and streaming contents received through the Internet, a streaming contents guide function and an electronic program

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guide (hereinafter, referred to as "EPG") function are integrated to display an "integrated contents guide" that enables the user to check the streaming contents and the television programs at a glance on one screen. FIG. 2 shows an example of displaying the integrated contents guide.

In FIG. 2, a vertical axis indicates broadcast time slots. A horizontal axis of FIG. 2 contains a display area 201 for streaming contents programs and a display area 202 for television broadcast programs. In the display area 201, two streaming contents programs are displayed for each time slot. In the display area 202, broadcast channels are displayed along a direction of the horizontal axis.

A cursor 203 for selection can be arbitrarily moved by operating an up/down/left/right key of the remote control 114. An area 204 displays detailed information related to a program designated by the cursor 203.

The generated guide screen is sent to the display screen generator 112, and displayed on the display 113 by being synthesized with or replacing main data to be displayed such as video, audio, and data sent from the media decoder 109.

On the other hand, the Internet connector 105 as hardware represents a connector (such as modem or router) for connecting to a communication line such as a telephone line, CATV, ADSL, or FTTH. The Internet connector 105 as software represents middleware (a protocol stack) that supports: a relatively low-order Internet protocol corresponding to the transport layer and the network layer, such as TCP, UDP, or IP; and a protocol corresponding to the application layer which differs depending on the kinds of streaming contents. The Internet connector 105 is utilized to access an external Web server through the Internet 1, and receive various audio-visual data including streaming contents and various information from the Web server. Note that the Internet connector 105 is capable of simultaneously accessing (establishing sessions for) a plurality of Web servers or plural sets of contents in the servers.

The data buffer 106 is a buffer memory for accumulating data of streaming contents, and stores streaming data of current and next preferences of contents and meta-information as related information thereof. An operation of the data buffer 106 will be described later.

The meta-information separator 107 extracts and separates the meta-information of streaming contents. Here, the meta-information represents information related to streaming contents (profile of contents), and includes a file called a metafile sent from the streaming server side before actual contents distribution and information described in a header section of main data of contents. Also, profile information of contents may recently be included in a file described in a Synchronized Multimedia Integration Language (hereinafter, referred to as "SMIL").

In many cases, the metafile includes, as the profile information of contents, a description of a destination link related thereto in addition to an entity of meta-information. Therefore, by referring to the metafile and following the destination link described therein, the profile information of the contents can be obtained as a series of meta-information.

The meta-information includes information on contents such as a location address, a title, a genre, an abstract, a reproduction time period, whether recording is permitted or not, and a producer name. In addition, a logo and the like of the contents can be obtained by following the destination link.

The meta-information separator 107 extracts the meta-information including the address of the currently displayed contents, and the meta-information memory 108 stores the meta-information. Even if the kinds of streaming contents are different, contents (description contents) of their meta-information

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are similar to each other, but differ in description format. Thus, the meta-information separator 107 of this embodiment is adapted to interpret metafiles of such plural kinds of streaming contents.

The streaming contents data accumulated in the data buffer 106 is sent to the media decoder 109, and decoded according to description languages and coding systems used for the respective data. As described above, in this embodiment, the media decoder 109 has the decoding function for both the digital broadcast system and the streaming broadcast system.

The remote control 114 serves as an important user interface. In the case of receiving streaming contents, a user directly operates the remote control 114 based on the integrated guide screen displayed on the display 113 to select desired contents. In addition to a function for switching channels as a remote control for television, the remote control 114 is added with a function for inputting and selecting a URL (text).

The command receiver 115 receives a command from the remote control 114, and sends the command to the controller 121. Based on the content of the command, the controller 121 performs switching to contents selected by a user, turning up/down a volume, turning on/off a power, or the like.

The current meta-information memory 120 is a non-volatile memory, and stores the meta-information of streaming contents that are being audiovisually enjoyed by a user. Every time the user performs switching the audiovisually enjoyed contents or the like operation, the current meta-information memory 120 constantly stores the meta-information of the latest audiovisually enjoyed contents. Note that the meta-information stored in the current meta-information memory 120 includes at least address information.

The timer 117 includes a general function of a calendar and a clock. In addition, the timer 117 includes a timer that starts a timer operation by an instruction of the controller 121 and outputs a timing signal for instructing periodical connection to the controller of Internet connection 116 during a power off state.

At the timing instructed by the timer 117, based on the information stored in the current meta-information memory 120, the controller of Internet connection 116 performs connection setting on the Internet connector 105 so as to access the URL of streaming contents that are audiovisually enjoyed by a user in the last time.

Next, description will be made of an operation according to this embodiment.

FIG. 4 is a flow chart showing a process of the controller 121 accompanied by turning on/off of the power.

If a user operates a power switch of the remote control 114 to turn on the power source 125 of the receiving apparatus 100 shown in FIG. 1B (step S111), in addition to the main power source 126, the power source 125 also starts to supply a power to function blocks. Then, connection is established with a previously designated portal site related to streaming contents, and information described in HTML, etc. in the site and meta-information related to streaming contents registered therein are received and stored in the meta-information memory 108 (steps S112 and S113).

The meta-information received here includes a location address, a title, a category (genre), an abstract, a reproduction time period, whether recording is permitted or not, and a producer name. If possible, a distribution schedule and the like are also obtained from the information contained in the portal site.

A series of meta-information related to contents which is stored in the meta-information memory 108 is decoded in the

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SI/metainformation decoder 110, and displayed as a contents guide screen on the display 113 (step S114).

As described above, in the receiving apparatus 100, the streaming contents guide function and the EPG function for digital broadcasts are integrated to display the "integrated contents guide" that enables the user to check the streaming contents and the television programs at a glance on one screen.

Naturally, as a simpler display method, an Internet browser application may be installed to receive data from several portal sites related to streaming contents which exist on the Internet and display the data as it is.

Here, if a user designates contents (step S115), metainformation of the selected contents is stored in the current metainformation memory 120 (step S116). As the current metainformation memory 120, a semiconductor memory such as a flash memory can be used. In addition, if a hard disk drive is provided for recording contents and programs, a partial area of the hard disk may be used for the current metainformation memory 120. Further, although not particularly shown in FIG. 1A, an external memory device connected to the receiving apparatus 100 through a network can serve as the current metainformation memory 120.

The Internet connector 105 starts to receive data from the address of the designated contents. The data is passed through the data buffer 106, the media decoder 109, and the display screen generator 112 to be outputted to the display 113 for displaying the streaming contents.

Further, in the case where a user audiovisually enjoys one set of contents for a predetermined time period of longer without interruption, the metainformation memory 108 stores the metainformation in the current metainformation memory 120.

After starting to thus receive the streaming contents, a state of the power is checked (step S117). In the case where a power on state continues here and a user switches the streaming contents, the metainformation related to the latest audiovisually enjoyed contents is stored in the current metainformation memory 120 for every switching. Therefore, in the case of a power off state, the metainformation of the previously audiovisually enjoyed contents is stored in the current metainformation memory 120.

Subsequently, the controller 121 detects the power off state of the power source 125 caused by the operation for turning off the power switch of the remote control 114 or the like operation, the controller 121 instructs the timer provided to the timer 117 to start the timer operation, and sets a period for outputting a timing signal during the power off state (step S118).

Simultaneously, the controller of Internet connection 116 reads the metainformation of the contents, which are previously audiovisually enjoyed immediately before the power off, from the current metainformation memory 120 (step S119), and sets the URL of the contents to the Internet connector 105 (step S120).

The Internet connector 105 accesses the URL of the contents that are previously audiovisually enjoyed immediately before the power off, and receives the streaming data from the site (step S121). The data buffer 106 stores the streaming data (step S122). Thus, the streaming contents are always buffered immediately after the power off.

Here, the power off state in this embodiment represents a state where the power source 125 of the receiving apparatus 100 is turned off by the remote control 114 as a generally expected state, assuming that the main power source 126 is kept in an on state. Naturally, while the power source 125 is in an off state, the timer function of the timer 117 may be

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operated and the timer may be used to appropriately supply a power only to a necessary function block other than the timer 117, for example, the streaming contents receiving function block 122 or the controller 121, which can be selected by setting in the controller (a power state manager) 121.

Further, while the power source 125 for the receiving apparatus 100 is in an off state, the timer 117 outputs the timing signal at the set period (step S123). The controller of Internet connection 116 controls the Internet connector 105 according to the timing signal, and periodically repeats in a background the operation for receiving the data of the streaming contents that are audiovisually enjoyed immediately before the power off and storing the data into the data buffer 106. Accordingly, the latest data is constantly accumulated in the data buffer 106. The above operations are normally performed because the main power source 126 is in an on state.

Subsequently, if the power source 125 is turned on by a user operation (step S124), the power is also supplied to the digital broadcast distribution receiving function block 123 and the another function block 124. Therefore, the controller 121 reads the data of the streaming contents accumulated in the data buffer 106 as described above, and decodes the data in the media decoder 109 (step S125). Then, the controller 121 controls the display screen generator 112 to generate a display screen of the streaming contents, and outputs the display screen to the display 113 (step S126). The controller 121 also instructs the controller of Internet connection 116 to establish connection to the address of the streaming contents. The controller of Internet connection 116 follows the instruction by controlling the Internet connector 105 to start to receive the streaming contents. After that, the streaming contents are consecutively reproduced and audiovisually enjoyed without interruption.

Note that in the case where the power source 125 is turned off when streaming contents are being audiovisually enjoyed, it may be determined by an apparatus specification which of the streaming contents, a television program, and a contents guide screen will be displayed at the start next time when the power is turned on. In this embodiment, in the case where the power is turned off when streaming contents are being audiovisually enjoyed, it is assumed that the streaming contents are displayed at the start. According to this embodiment, the audiovisual enjoying of the streaming contents can be started in the same manner as the case where a channel that is previously audiovisually enjoyed immediately before the power off is displayed at the start when the power of a general television set is turned on.

As described above, according to this embodiment, in the case where the power source 125 is turned off when streaming contents are being audiovisually enjoyed, the address of the streaming contents that are audiovisually enjoyed immediately before the power off is stored, the streaming contents are periodically received and accumulated during the power off state. Then, at the power on, the streaming contents data accumulated during the power off state are read and decoded to be displayed. Concurrently, the data restarts to be received from the address of the streaming contents that are received immediately before the power off. Accordingly, a user can automatically and promptly start to audiovisually enjoy the streaming contents that are audiovisually enjoyed immedi-

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ately before the power off, without instructing another operation, such as selecting or receiving of the streaming contents, at the power on.

Embodiment 2

Next, description will be made of Embodiment 2. Note that, main blocks of a receiving apparatus according to this embodiment are the same as those shown in FIG. 1B.

FIGS. 5A to 5C are flow charts showing a basic operation of the controller 121 according to this embodiment.

In FIGS. 5A to 5C, when the power is turned on (step S211), the Internet connector 105 connects to a portal site of streaming contents designated in advance, and receives meta-information related to the streaming contents registered in the portal site (step S212). The meta-information is stored in the meta-information memory 108 (step S213). This process is substantially the same as that of the above-mentioned embodiment. However, in this embodiment, this process is performed while a user is not audiovisually enjoying streaming contents.

Next, after checking a present time, the meta-information related to the streaming contents registered (displayed) at an integrated contents guide is stored in the current meta-information memory 120 (step S214).

Also in this embodiment, there is displayed an "integrated contents guide" shown in FIG. 2 which enables a user to check streaming contents and television programs on a single screen at a glance.

In FIG. 2, four sets of streaming contents are registered in a time slot of 19 hours that is a present time slot. A user is likely to select and audiovisually enjoy one from the four sets of the streaming contents as in the case of selecting a television program.

In this case, first, as to the four sets of streaming contents, meta-information related to the above streaming contents is extracted from the meta-information memory 108, and the extracted meta-information is written into the current meta-information memory 120. Further, information related to streaming contents that can be audiovisually enjoyed from a list in FIG. 2 (two programs listed in 20 hours, 21 hours, and 22 hours, respectively) is sequentially stored in the current meta-information memory 120 (step S215).

The controller of Internet connection 116 controls the Internet connector 105 according to the meta-information of the contents stored in the current meta-information memory 120 such that connection is established to an address of this streaming contents (step S216).

The Internet connector 105 accesses a URI of the designated contents and receives streaming contents data, which is then stored into the data buffer 106. (steps S217 and S218).

As described above, the number of the sets of streaming contents registered at the contents guide is not necessarily one. In the case where plural sets of contents are registered, according to an instruction from the controller of Internet connection 116, the Internet connector 105 can access URLs of plural contents preferences at the same time and receive the streaming contents data in parallel.

On the other hand, the number of sets of contents that can be accumulated in the data buffer 106 varies depending on a capacity of the data buffer 106. Unlike the broadcast system, there mixedly exist video and audio having various resolutions and distributing rates in the streaming contents. In general, contents with a higher resolution and a higher distribution rate require a larger buffer capacity.

For that reason, in this embodiment, an allocation capacity for the respect sets of contents is dynamically determined by

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checking distribution information such as a resolution and a recommended distribution rate of the respective contents from the meta-information of the target contents, and by checking a traffic (congestion) state of a communication channel of interest in the Internet connector 105 and calculating a substantial line speed.

At this time, a capacity is allocated, which is large enough to ensure that neither image deterioration nor interruption occurs and audiovisual enjoying can be smoothly started in the respective contents (step S219).

Note that, the data buffer 106 in this embodiment has a capacity sufficient enough to accumulate data for a predetermined time period of all data related to contents displayed on a list on the contents guide screen. Accordingly, when the user selects one from the plural sets of the streaming contents that are registered in a range that can be listed at the contents guide, the selected contents data is certainly stored in the buffer 106.

In this embodiment, the process from step S212 to step S219 is performed while the user is not audiovisually enjoying streaming contents (for example, the user is audiovisually enjoying a television program). In addition, the process may be performed immediately after the power of the receiving apparatus 100 is turned on, for example. In particular, the process performed immediately after turning the power on is necessary when the receiving apparatus 100 is actually in an initial condition. Whether or not this process is performed immediately after the power is turned on depends on specifications of receiving apparatuses. In the case of a receiving apparatus that performs a buffer operation while the apparatus power is in an off state, this process is not necessarily performed every time immediately after the power of the receiving apparatus is turned on. In contrast, in the case of a receiving apparatus that cannot perform the buffer operation while the apparatus power is in an off state, this process is necessarily performed immediately after the power is turned on.

Description will be again made of the operation flows of FIGS. 5A to 5C.

After the above process, the contents guide screen is displayed according to an instruction from the user (step S220). The user then performs a contents selection operation (step S221).

Here, in the case where the contents selected by the user are not streaming contents, for example, a case of a television program, the tuner 101 is controlled to receive a broadcast of a designated channel, and the selected program received and audiovisually enjoyed (steps S223 and S224). Further, in the case of another application, for example, a case of receiving and audiovisual enjoying data from an external device, or processing electronic mail or the like, a process is similarly performed correspondingly to the application (step S225).

On the other hand, in the case where the selected contents are streaming contents, it is judged whether or not the selected streaming contents are buffered in the data buffer 106 in advance (step S226). In the case of the buffered contents, the corresponding data is read from the buffer 106 (step S227). Then, the controller of Internet connection 116 performs connection setting on the Internet connector 105 to connect to an address of the streaming contents selected by the user and start to receive the selected contents from the server (steps S229 and S230). After that, the controller sequentially receives the streaming contents data and decodes the data read from the data buffer 106 to generate a display screen, and the display screen is displayed on the display 113 (step S228).

In this manner, when streaming contents displayed at the display guide are selected, a beginning part of this designated

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streaming contents is accumulated in the data buffer 106 in advance. Therefore, the user can start to audiovisually enjoy the contents dramatically more quickly as compared with the case where after the contents are designated, the Internet connector 105 connects to a corresponding site to receive the streaming data related to the designated contents.

In addition, there may be the case where the user selects and audiovisually enjoys streaming contents that are not registered in the contents guide. In such a case, an instruction is given to the Internet connector 105 as in the usual case to access a designated site. The user audiovisually enjoys while downloading the streaming contents from the designated site.

In this way, by receiving and accumulating in advance streaming contents registered at the contents guide while the streaming contents are not audiovisually enjoyed or immediately after the power is turned on, at the time of selecting streaming contents from the contents guide screen later, the user can audiovisually enjoy the streaming contents without delay in such a manner as to feel as comfortable as when switching channels on television.

After that, it is judged whether or not a change of registered contents exists at the contents guide, which is then reflected on the sequent buffering process (step S231). In a configuration adopted in this embodiment, the user can freely register or delete the streaming contents at the contents guide. When the change exists, the buffering process is performed again on the registered contents after the change.

Next, a background buffering operation while the power is in an off state is described.

According to this embodiment, a power off state means a state where the power of the receiving apparatus 100 is turned off using the remote control 114.

When an instruction of turning the power off is made through the remote control by the user (step S232), the controller 121 discriminates a present time (step S234), and sets a period for outputting a timing signal (step S235).

Next, a control is made such that the controller of Internet connection 116 reads metainformation related to streaming contents, which are registered in a range that can be listed at the contents guide with a present time as a starting point, from the current metainformation memory 120 (step S236), and outputs the metainformation to the Internet connector 105 (step S237).

The Internet connector 105 accesses a URL of the respective outputted contents, receives streaming data thereof, and stores the data in the data buffer 106 (steps S238 to S240).

Here, in the case where plural sets of target contents exist, as is described above, the Internet connector 105 accesses URLs of the plural contents preferences at the same time, and receives streaming data more efficiently.

Further, while the power is in an off state, according to timing signals from the timer 117, the Internet connector 105 repeats an operation for receiving streaming contents data periodically and storing the data in the data buffer 106 (step S241). With this configuration, it is possible to constantly accumulate the latest data of the streaming contents registered at the streaming contents guide in the data buffer 106 all the time.

Next, when the power is turned on by a user operation, the contents guide screen of FIG. 2, for example, is presented as an initial screen (step S242).

The user then selects contents. In the case where the user selects contents from the streaming contents registered at the contents guide, the data related to the selected contents is accumulated in the buffer 106 in advance. Thus, the user can start to audiovisually enjoy the streaming contents without delay.

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As described above, according to this embodiment, by accumulating in advance streaming contents registered at the contents guide while the power is in an off state, after turning the power on, at the time of selecting streaming contents from the contents guide screen, the user can start to audiovisually enjoy the streaming contents without delay in such a manner as to feel as comfortable as when switching channels on television.

Embodiment 3

Next, description will be made of Embodiment 3. A receiving apparatus according to this embodiment has the same configuration as that shown in FIG. 1, except that the controller 121 has a function of managing operating states (activation, shutdown) of various applications incorporated in the receiving apparatus 100. The application here includes one referred to as "application" in a PC in general such as electronic mail and Internet browsing and also includes audiovisually enjoying of television programs, audiovisually enjoying of streaming contents, and audiovisually enjoying of contents inputted from an external audiovisual device as well.

FIG. 6 is a flow chart showing an operation of the controller 121 when the streaming contents audiovisual enjoying is switched to the television program audiovisual enjoying, according to this embodiment.

In FIG. 6, a process from step S311 to step S316 is a process in which metainformation of the latest streaming contents selected by the user is stored in the current metainformation memory 120 after the power is turned on. The process is the same as that from step S111 to step S116 of FIG. 4.

Next, in step S317, it is judged whether or not the contents to be audiovisually enjoyed is switched from the streaming contents to another application such as a television program.

Here, when it is judged that the switching is made to another application such as a television program, an instruction is issued such that the timer 117 starts timekeeping, and a period is set for a outputting a timing signal (step S318). While another application is activated, a URL of the streaming contents audiovisually enjoyed periodically immediately before the switching is read from the current metainformation memory 120, and the streaming contents are received, and accumulated in the buffer 106 (steps S319 to S323). Also in this embodiment, those processes are performed in the background so that audiovisual enjoying of the television program by the user is not disturbed.

After that, in the case of selecting the streaming contents again by a remote control, it is judged that the streaming audiovisual enjoying is started (step S324), the data of the streaming contents audiovisually enjoyed immediately before the switching is read from the data buffer 106 to send the data to the media decoder 109, and the display is then started. In addition, the streaming contents data starts to be received, and thereafter the user audiovisually enjoys the streaming contents while the data is sequentially accumulated in the data buffer 106.

In this manner, in this embodiment, when an instruction to switch to another application is given during audiovisual enjoying of the streaming contents, streaming contents data immediately before the switching is periodically received and the data is accumulated in the data buffer 106 during audiovisual enjoying of the another application. Then, in the case where the instruction to switch to the streaming contents is given again, the accumulated streaming contents data is read to be displayed.

For that reason, it is possible that the streaming contents and the general television program are switched over to one

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another quickly, for example. The user does not feel stress and can switch the audiovisual enjoying contents in such a manner as in zapping.

Embodiment 4

FIG. 3 is a diagram showing main blocks of a receiving apparatus 300 according to this embodiment. The receiving apparatus 300 shown in FIG. 3 has substantially the same function as that of the receiving apparatus 100 shown in FIG. 1A. Also, blocks of FIG. 3 having the same function as those of FIGS. 1A and 1B are denoted by the same reference numerals.

Hereinbelow, functions of blocks added to or replaced in FIGS. 1A and 1B are described.

In FIG. 3, the controller 121 recognizes a command received by the command receiver 115 from the remote control 114. Based on the content of the command, the controller 121 determines which streaming contents and television programs a user audiovisually enjoyed, and sends the history to an audiovisual enjoying history memory 140.

In addition to the above-mentioned function, the timer 117 provides the audiovisual enjoying history memory 140 with a date, a day of the week, and a time at which the user audiovisually enjoyed the streaming contents and the television programs. Note that, in this embodiment, the audiovisual enjoying history memory 140 is controlled to record the history therein only when the user audiovisually enjoys streaming contents and a television program continuously for a predetermined period of time.

The audiovisual enjoying history memory 140 stores a history as to which contents in which site the user audiovisually enjoys. Parameters to be stored include a URL, a title, and a genre of contents, a date, a day of the week, and a time when the user audiovisually enjoyed the contents, and the like.

A user profile generator 141 performs a calculation process based on a predetermined algorithm using data inputted from the audiovisual enjoying history memory 140 to generate a user profile that is pattern data concerning contents audiovisual enjoying of the user, and stores the profile in a user profile memory 142.

Note that, this user profile concerning contents audiovisual enjoying is main individual profile data for respective users who use the receiving apparatus 300. In the case where the receiving apparatus is used in an ordinary household, profiles for respective family members (father, mother, and child) are independently accumulated and managed. In this regard, in some cases, those profiles for respective members may be accumulated collectively, not independently, as a single profile for the family.

A unit for estimating contents 143 estimates and determines a contents preference that may be selected by the user from among contents that are stored in the current metainformation memory 120 and can be audiovisually enjoyed from a present time or in a few hours, based on the predetermined algorithm and the user profile data concerning contents audiovisual enjoying stored in the user profile memory 142.

The controller of Internet connection 116 performs connection setting on the Internet connector 105 to access a URL of streaming contents corresponding to an instruction from the unit for estimating contents 143 in accordance with a timing signal from the timer 117.

Next, operations according to this embodiment will be described.

FIG. 7 is a flow chart showing an operation of the controller 121 when receiving streaming contents in this embodiment.

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In FIG. 7, when the power of the receiving apparatus 300 is turned on, the Internet connector 105 connects to a portal site of streaming contents designated in advance, receives metainformation related to the streaming contents registered in the portal site, and stores the metainformation in the metainformation memory 108 (steps S411 to S413). This process is the same as in the above-mentioned embodiments.

Next, metainformation related to streaming contents that can be audiovisually enjoyed at a present moment or in a few hours is extracted from the metainformation memory 108 and stored in the current metainformation memory 120 (step S414).

Next, after the timer 117 discriminates a present date and time, and a day of the week (step S415), the unit for estimating contents 143 estimates and determines a contents preference that may be selected by the user for streaming audiovisual enjoying next time by referring to the user profile data concerning contents audiovisual enjoying and the data stored in the current metainformation memory 120 (steps S416 and S417).

Here, in the case where identical site addresses of contents exist in histories of the past contents audiovisual enjoying with reference to the same time on the same day of the week, it is easy to estimate and determines the audiovisual enjoying contents preference based on the above information. When there are no contents having identical addresses to each other, the unit for estimating contents 143 estimates and determines a preference from profile information of contents themselves, such as a title, a category, and a producer of the contents, irrespective of addresses and distribution information such as a day of the week and a time.

When the next contents preference is determined, an address of the contents preference is sent to the controller of Internet connection 116, and the address of the above next contents preference is set in the Internet connector 105 (step S418). The Internet connector 105 accesses the address of the above next contents preference to receive streaming data and stores the data in the data buffer 106 (steps S419 and S420).

Here, the number of the contents preferences outputted from the unit for estimating contents 143 is not necessarily one. In many cases, several to ten and several contents preferences are outputted therefrom. For that reason, in this embodiment, the number of the next preferences to be buffered is also not only one, but plural contents preferences (second preference, third preference) are buffered. In such a case, the Internet connector 105 accesses URLs of the plural contents preferences at the same time and receives the streaming contents data in parallel according to an instruction from the controller of Internet connection 116.

In addition, a managing mode of the data buffer 106 when receiving and buffering plural sets of contents (capacity allocation to the respective sets of contents) is the same as that of Embodiment 2. That is, a capacity is allocated, which is large enough to ensure that audiovisual enjoying can be smoothly started in the respective contents.

In this way, the operation for receiving and buffering the next contents preference is repeated until the data buffer 106 installed in the receiving apparatus 300 is loaded with the next contents preference data (step S421). Basically, in a state where the data buffer is loaded with the next contents preference data, the receiving apparatus waits for a user to select contents.

Based on the same concept as in Embodiment 2, those processes are performed in a time slot in which the user is not audiovisually enjoying streaming contents (for example, the

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user audiovisually enjoys a television program) or immediately after the power of the receiving apparatus 300 is turned on.

After that, the contents guide screen is displayed by an instruction from the user (step S422), and the user performs an operation for selecting contents (step S423).

Similarly to Embodiment 2, in the case where the contents selected by the user are not streaming contents at this time, for example, in the case of a television program, the tuner 101 is controlled such that the user audiovisually enjoys a predetermined program, and the user receives and audiovisually enjoys the selected program (steps S425 and S426). Further, in the case of another application, for example, a case of audiovisually enjoying of an image from an external audio-visual device, or electronic mail, a process is similarly performed correspondingly to the application (step S427).

On the other hand, in the case where the selected contents are streaming contents, it is judged whether or not the selected streaming contents are previously estimated as the next contents preference and buffered in the data buffer 106 (step S428). When it is judged that the contents are buffered in advance, the corresponding data of the accumulated streaming contents is read from the buffer 106 to be sent to the decoder 109 (step S429). Then, the controller of Internet connection 116 performs connection setting on the Internet connector 105 to connect to an address of the streaming contents selected by the user, and starts to receive the selected contents from the server, and thereafter the user audiovisually enjoys the selected streaming contents continuously while renewing the data buffer 106 sequentially (steps S431 and S432).

In this manner, by buffering data of a streaming contents preference in advance that may be selected by the user, when the user selects the corresponding contents, it is possible to start audiovisual enjoying of the contents without delay. Therefore, the contents can be displayed dramatically more quickly as compared with the case where after the contents are designated, the Internet connector 105 connects to a corresponding address to receive the streaming data related to the designated contents.

On the other hand, in the case where the contents selected by the user do not exist in the streaming contents that are accumulated as the next contents preferences, an instruction is given to the Internet connector 105 as in the usual case to access a designated site. The Internet connector 105 receives the streaming contents from the designated site.

Regardless of matching or mismatching of the selected streaming contents with the next contents preference, after the streaming contents is selected, when it is judged with the timer 117 that the user audiovisually enjoys the selected streaming contents continuously for a given length of time (step S433), the result is stored in the audiovisual enjoying history memory 140 (step S434). After that, as appropriate, the user profile is renewed (step S435). Note that, this profile renewal may be performed as needed if the CPU throughput of the apparatus can afford. If the throughput has no room, the renewal may be performed every given period of time or performed in a time slot in which audiovisual enjoying is not usually performed by the user such as a late evening slot.

After the renewal of the profile, if necessary, a new contents preference is estimated based on the renewed user profile, data of this new contents preference is received, and accumulated in the data buffer 106. Depending on the CPU throughput, the operation is performed such that a new contents preference is estimated every time the user profile is renewed in order to prepare for the next audiovisual enjoying.

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FIG. 8 shows an example of the user profile data used in this embodiment. In FIG. 8, "cnt_URL" represents a location address and file name (URL) of the contents audiovisually enjoyed by the user. "CRID" represents a reference ID of the contents concerned. A contents reference ID is an ID for specifying the main contents data, independent of the URL for specifying the contents location. The contents reference ID is written in a format showing a producer name and a classification name (category and series title of the contents) that is managed to assure uniqueness of the contents for each producer. Note that, in FIG. 8, a notation "AAA/Sport" represents streaming contents in a management category of sports related to a producer or contents distribution manager called "AAA".

"Cat_ID" represents a category of the contents concerned. Specifically, examples of the category includes news, sports, drama, and education. In the case of streaming contents, at present, an original categorization is made for the respective contents producers and contents distribution managers.

Note that, standardization of MPEG-7 and TV-Anytime has been progressed in standard-setting organizations such as Moving Picture Experts Group and TV-Anytime Forum in order to set a scheme with which contents employing televisions, the Internet, package media, etc., as media, are uniquely specified irrespective of types of the media. When meta-information and a contents localization method are standardized in the future by the activities of the organizations, it becomes possible to utilize the meta-information based on the resultant standard.

"Date", "Day", and "Time" represent date, a day of the week, and a time, respectively, at which the user audiovisually enjoys the contents. These information are inputted by the timer 117 of the receiving apparatus 300.

"Rec" represents whether or not the user records the contents by recording means (not shown). For the estimation of the next contents preference in this embodiment, this recording history is used and treated as the audiovisual enjoying history.

Note that, although a function block as the recording means is not shown in FIG. 3, an external recording apparatus to be connected to the receiving apparatus 300 via an interface is assumed as the recording means. The recording history is accumulated through an instruction by the user with a remote control operation using the above-mentioned streaming contents guide screen or the like.

"Date_Stamp" represents the latest day on which an event (contents audiovisual enjoying) concerned occurs. Similar to "Date", "Day", and "Time", "Date_Stamp" is inputted by the timer 117 of the receiving apparatus 300. "Freq" represents a frequency of occurrence of the event.

In addition, a notation "-1" shown in FIG. 8 means "Don't care", in other words, "irrespective of this parameter value".

For example, in FIG. 8, the top line indicates that: irrespective of the date (-1 notation), on Saturday (Day=6), at 7 p.m. (Time=19), there are in the past 10 audiovisual enjoying histories (Freq=10) of streaming contents called "Filename1" in a contents distribution site (ServerA) called "AAA". At the same time, it is understood that the category of the contents is sports (Cat_ID=2), and the latest audiovisual enjoying is made on 28 of Apr., 2001.

Note that, although specific description of category ID is omitted here, several examples are shown in FIG. 8. A certain number (ID) is allocated for the respective categories in the apparatus. The category information obtained from the contents meta-information is recorded in the profile in the form of number by using a predetermined comparison table or the like.

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The fifth line from the top of FIG. 8 indicates that: irrespective of a day of the week and a date (Date and Day--1), at 7 a.m. (Time--07), there are in the past 20 audiovisual enjoying histories of streaming contents "Filename24" in a contents distribution site "GGG".

The next contents preference is determined by referring to such a user profile as shown in FIG. 8 and performing a calculation process based on a predetermined algorithm. As an example, the order of next contents preferences is change under a predetermined condition, and filtering is then performed. At a certain timing of contents inference, when a condition that completely matches with one in the profile does not exist, several parameters are set to "Don't care", so that more generally matching contents is found and set as the next contents preference.

More specifically, by putting weight on parameters of the category of the contents themselves or the like rather than parameters of audiovisual enjoying histories, contents in a genre that the user may prefer are selected as the next contents preference from the group of contents that can be audiovisually enjoyed, if such contents exist.

Note that, the user profile shown in FIG. 8 is a history data having a unit of 1 hour as a time parameter for simplification of description. However, in reality, a history is left with a much higher frequency. In this embodiment, every time the user profile is renewed, the operation for estimating the next contents preference is performed.

Further, it is possible to generate a user profile in which not only audiovisual enjoying histories but also television program audiovisual enjoying histories are taken into consideration. In such a case, information on genre and titles in particular among information concerning television programs can be treated as parameters commonly used with meta-information of streaming contents. Therefore, it is possible to understand which kind of contents the user prefers more accurately from a large number of viewpoints. With this configuration, there is an effect that the inference of the next contents preference becomes more accurate.

Further, in order to increase a relevance ratio of the next contents preference to be buffered, a sufficient amount of audiovisual enjoying histories are necessary. Therefore, in an early stage of the apparatus use, initial data of the user profile may be generated as follows. A screen is presented to the user to inquire his/her interest and favorites, and from the screen the user selects or inputs a favorite genre and other given items.

Further, in the apparatus shown in FIG. 3, a series of operations, in which audiovisual enjoying contents are estimated based on the user profile, and buffering is performed in advance as described above, can be carried out while the power is in an off state. The fundamental operation flow in this case is basically the same as that of the background buffering flow during the power off state (steps S232 to S242 of FIGS. 5B and 5C). Only the difference is that the contents to be buffered are streaming contents registered at the contents guide in Embodiment 2, but are streaming contents inferred based on the user profile in this embodiment.

As described above, while the user is not audiovisually enjoying the streaming contents or the power is in an off state, based on the user profile generated from the audiovisual enjoying histories, contents that the user may audiovisually enjoy are estimated, and a part of the streaming contents data is buffered. As a result, the waiting time period, which is required in the conventional audiovisual enjoying is eliminated at the time of starting audiovisual enjoying or switching contents. Accordingly it is possible to select and audiovisually enjoy the contents smoothly.

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As has been described above, according to the present invention, the streaming contents, which are received immediately before the power is turned off, are periodically received and accumulated during the power off state. Accordingly, next time when the power is turned on, the streaming contents, which are audiovisually enjoyed immediately before the power off, can automatically and promptly start to be audiovisually enjoyed.

Further, according to the present invention, during the monitor stop for the streaming contents, the streaming contents are periodically received and accumulated. Accordingly, at the monitor restart for the streaming contents, the monitoring of the streaming contents can be promptly restarted.

Further, according to the present invention, the plural sets of the streaming contents are periodically received and accumulated based on the guide information. Accordingly, when a user select the streaming contents based on the guide information, the streaming contents can immediately start to be audiovisually enjoyed.

Further, according to the present invention, the streaming contents preferences estimated based on the user profile are periodically received and accumulated when the streaming contents are not audiovisually enjoyed, immediately after the power is turned on, or during the power off state. Accordingly, when the user select the streaming contents, the streaming contents can immediately start to be audiovisually enjoyed.

What is claimed is:

1. A receiving apparatus for receiving a moving image-streaming content through an internet, the moving image-streaming content being internet broadcasting content, said apparatus comprising:

a receiving unit for receiving a moving image-streaming content which is internet broadcasting content by an access through the internet to a URL of the streaming content;

a memory unit for storing URL information of the moving image-streaming content received by the receiving unit;

a display unit for displaying on a display screen the moving image-streaming content received by the receiving unit;

an operation unit for receiving an operation of turning off and turning on a power source for supplying power;

a buffering unit for buffering the moving image-streaming content received by the receiving unit; and

a control unit for (1) controlling, responsive to the receiving by the operation unit of the operation of turning off the power source, to read out the URL information stored in the memory unit, and (2) controlling, while the power source is in an off state, to periodically repeat accessing of a URL of the moving image-streaming content which had been displayed before the turning off the power source, so as to receive by the receiving unit and to buffer in the buffering unit the latest moving image-streaming content, and (3) controlling, responsive to the receiving by the operation unit of the operation of turning on the power source, to read out from the buffering unit the latest buffered moving image-streaming content and to start the displaying on the display screen of the latest buffered moving image-streaming content.

2. A receiving apparatus for receiving a moving image streaming content through an internet, the moving image streaming content being internet broadcasting content, said apparatus comprising:

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a first receiving unit for receiving a moving image-streaming content which is internet broadcasting content by an access through an internet to a URL of the moving image-streaming content;

a memory unit for storing URL information of the moving image-streaming content received by the first receiving unit;

a second receiving unit for receiving a television broadcast program transmitted through a broadcast signal;

an operation unit for receiving an operation of switching from a displaying of the moving image-streaming content on a display screen to a displaying of the television broadcast program on the display screen, and an operation of switching from the displaying of the television broadcast program on the display screen to the displaying of the moving image-streaming content on the display screen;

a buffering unit for buffering the moving image-streaming content received by the first receiving unit; and

a control unit for (1) controlling, responsive to the receiving by the operation unit of the operation of switching from the displaying of the moving image-streaming content on the display screen to the displaying of the television broadcast program on the display screen, (a) to stop the displaying of the moving image-streaming content on the display screen and to start the displaying of the television broadcast program on the display screen, (b) to read out the URL information stored in the memory unit, (2) controlling, while the television broadcast program is displayed on the display screen, to periodically repeat accessing of a URL of the moving image-streaming content which had been displayed before starting the displaying of the television broadcast program on the display screen, so as to receive by the receiving unit and to buffer in the buffering unit the latest moving image-streaming content, and (3) controlling, responsive to the receiving by the operation unit of the operation of switching from the displaying of the television broadcast program on the display screen to the displaying of the moving image-streaming content on the display screen, to read out from the buffering unit the latest buffered moving image-streaming content and to start the displaying on the display screen of the latest buffered moving image-streaming content.

3. The receiving apparatus according to claim 1, wherein the control unit is further configured to, responsive to the receiving by the operation unit of the operation of turning on the power source, (a) read out the URL information stored in the memory unit, (b) receive by the receiving unit the latest moving image-streaming content by accessing the URL of the moving image-streaming content which had been displayed before the turning off the power source, and (c) change the content displayed on the display screen from the latest moving image-streaming content, which had been buffered in the buffering unit while the power source had been in an off state, to the moving image-streaming content being received by the receiving unit.

4. The receiving apparatus according to claim 2, wherein the control unit is further configured to, responsive to the receiving by the operation unit of the operation of switching from the displaying of the television broadcast program on the display screen to the displaying of the moving image-streaming content on the display screen, (a) read out the URL information stored in the memory unit, (b) receive by the receiving unit the latest moving image-streaming content by accessing the URL of the moving image-streaming content which had been displayed before stopping of the displaying

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on the display screen, and (c) change the content displayed on the display screen from the latest moving image-streaming content, which had been buffered in the buffering unit while the television broadcast program had been displayed on the display screen, to the moving image-streaming content being received by the receiving unit.

5. A method for receiving a moving image-streaming content through an internet, the moving image-streaming content being internet broadcasting content, the method comprising: receiving a moving image-streaming content which is internet broadcasting content by an access through the internet to a URL of the streaming content; storing URL information of the moving image-streaming content; displaying the moving image-streaming content on a display screen; receiving an operation of turning off and turning on a power source for supplying power; buffering the moving image-streaming content;

after receiving of the operation of turning off the power source and before receiving of the operation of turning on the power source, reading out the URL information and periodically repeating accessing of a URL of the moving image-streaming content which had been displayed before the turning off the power source, so as to receive and buffer the latest moving image-streaming content; and responsive to the receiving of the operation of turning on the power source, reading out the latest buffered moving image-streaming content and starting the displaying on the display screen of the latest buffered moving image-streaming content.

6. The method according to claim 5, further comprising: responsive to the receiving of the operation of turning on the power source, (a) reading out the URL information, (b) receiving the latest moving image-streaming content by accessing the URL of the moving image-streaming content which had been displayed before the turning off the power source, and (c) changing the content displayed on the display screen from the latest moving image-streaming content, which had been buffered in the buffering unit when the power source had been in an off state, to the moving image-streaming content being received by the receiving.

7. A method for receiving a moving image-streaming content through an internet, the moving image-streaming content being internet broadcasting content, the method comprising: receiving a moving image-streaming content which is internet broadcasting content, by an access through an internet to a URL of the moving image-streaming content;

storing URL information of the received moving image-streaming content; receiving a television broadcast program transmitted through a broadcast signal; receiving an operation of switching from a displaying of the moving image-streaming content on a display screen to a displaying of the television broadcast program on the display screen, and an operation of switching from the displaying of the television broadcast program on the display screen to the displaying of the moving image-streaming content on the display screen;

buffering the moving image-streaming content; (1) responsive to the receiving of the operation of switching from the displaying of the moving image-streaming content on the display screen to the displaying of the television broadcast program on the display screen, (a) stop-

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ping the displaying of the moving image-streaming content on the display screen and starting the displaying of the television broadcast program on the display screen, and (b) reading out the URL information:

(2) while the television broadcast program is displayed on the display screen, periodically repeating accessing of a URL of the moving image-streaming content which had been displayed before starting the displaying of the television broadcast program on the display screen, so as to receive and buffer the latest moving image-streaming content; and

(3) responsive to the receiving of the operation of switching from the displaying of the television broadcast program on the display screen to the displaying of the moving image-streaming content on the display screen again, reading out the latest buffered moving image-streaming content and starting the displaying on the display screen of the latest buffered moving image-streaming content.

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8. The method according to claim 7, further comprising: responsive to the receiving of the operation of switching from the displaying of the television broadcast program on the display screen to the displaying of the moving image-streaming content on the display screen, (a) reading out the URL information, (b) receiving the latest moving image-streaming content by accessing the URL of the moving image-streaming content which had been displayed before stopping of the displaying on the display screen, and (c) changing the content displayed on the display screen from the latest moving image-streaming content, which had been buffered while the television broadcast program had been displayed on the display screen, to the moving image-streaming content being received.

* * * * *



US008078767B2

(12) **United States Patent**
Kotani

(10) **Patent No.:** **US 8,078,767 B2**
(45) **Date of Patent:** **Dec. 13, 2011**

(54) **DISPLAY APPARATUS, CONTROL METHOD THEREOF, AND PROGRAM**

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(75) Inventor: **Junji Kotani, Inagi (JP)**
(73) Assignee: **Canon Kabushiki Kaisha, Tokyo (JP)**
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 277 days.

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(21) Appl. No.: **12/545,270**

Primary Examiner — Ilwoo Park

(22) Filed: **Aug. 21, 2009**

(74) *Attorney, Agent, or Firm* — Fitzpatrick, Cella, Harper & Scinto

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. PCT/JP2009/055831, filed on Mar. 24, 2009.

(30) **Foreign Application Priority Data**

May 29, 2008 (JP) 2008-141678

(51) **Int. Cl.**
G06F 13/10 (2006.01)

(52) **U.S. Cl.** 710/8; 710/14; 710/15; 710/16

(58) **Field of Classification Search** None
See application file for complete search history.

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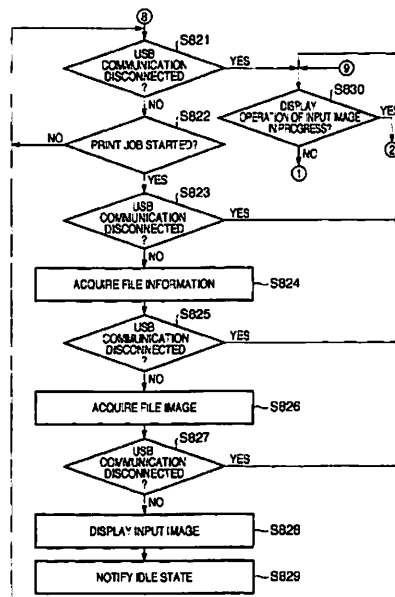
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(57) **ABSTRACT**

When a communication connection with a device is disconnected during execution of a display based on data transmitted from the connected device, it can be controlled to continue or end the display according to a class of the device. A display apparatus 1 includes a USB connector 102 used to connect an external device so as to be able to communicate with that device. The display apparatus 1 also includes a CPU 107 which controls to make a display based on data received from the external device with which a communication connection is established via the USB connector 102. The CPU 107 acquires class information indicating a class of the external device, the communication connection of which is established. When the communication connection with the external device is disconnected, if the acquired class information indicates a predetermined class, the CPU 107 controls to continue the display based on the received data, and if the class information does not indicate the predetermined class, the CPU 107 controls to end the display.

14 Claims, 28 Drawing Sheets



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FIG. 1A

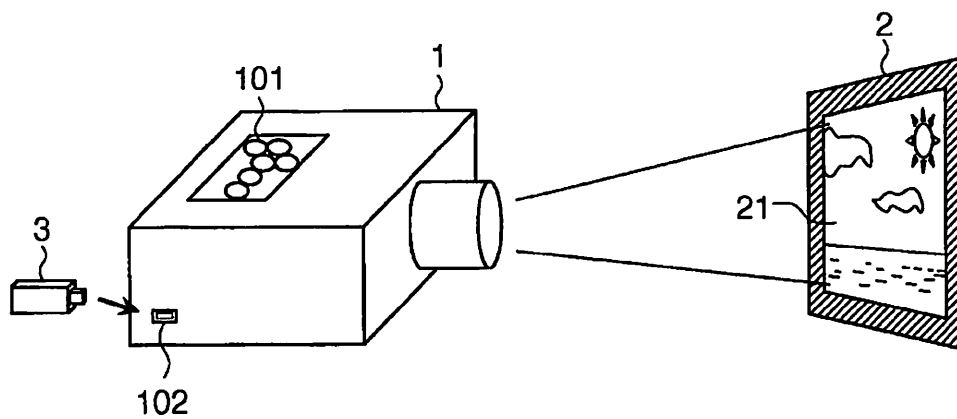


FIG. 1B

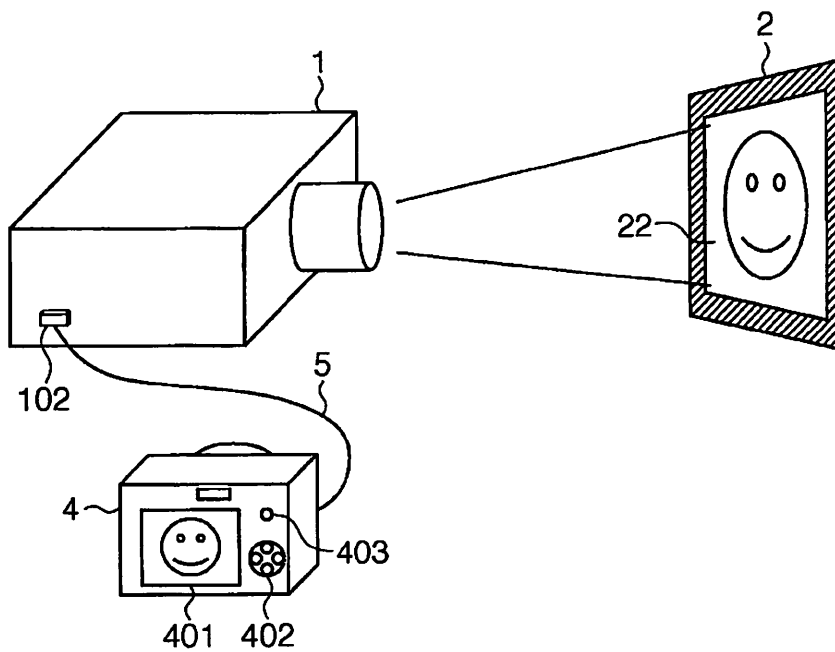
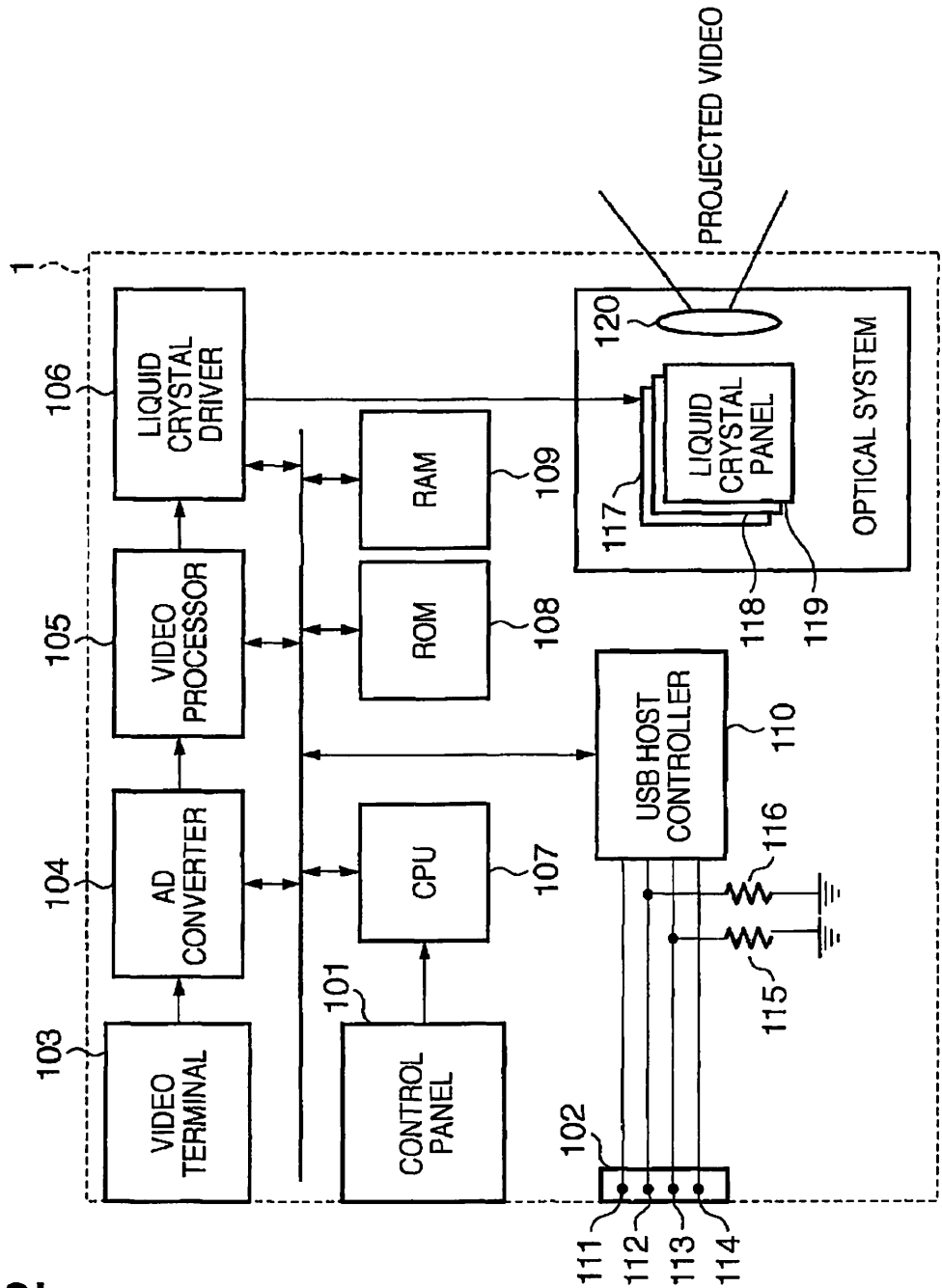


FIG. 2



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FIG. 3

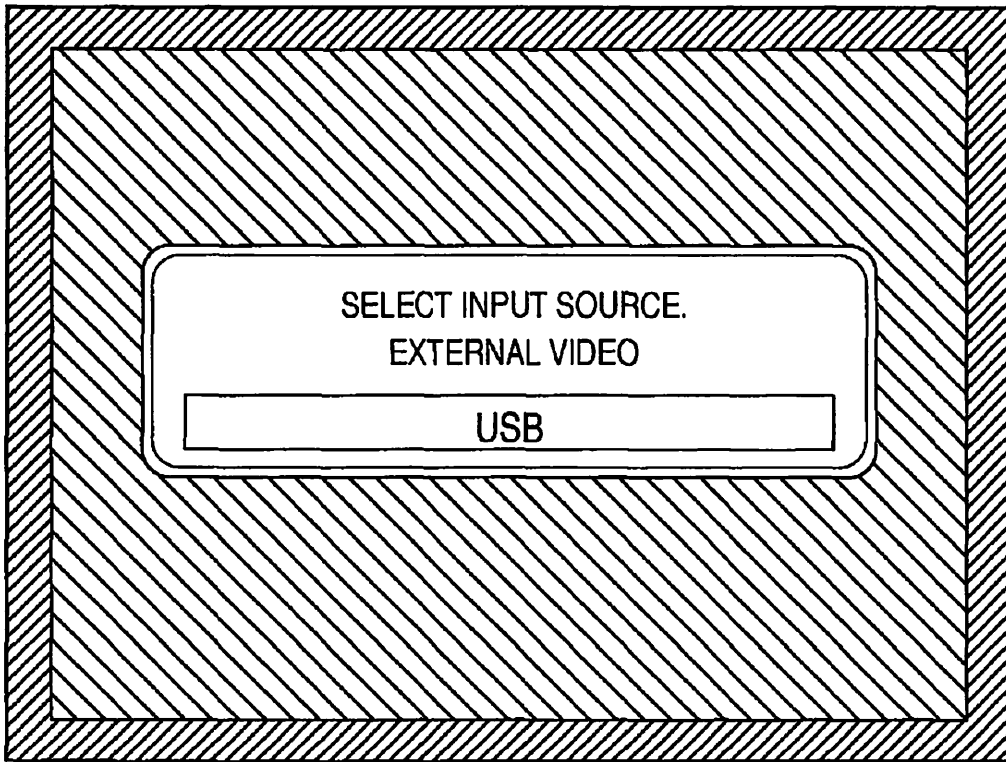
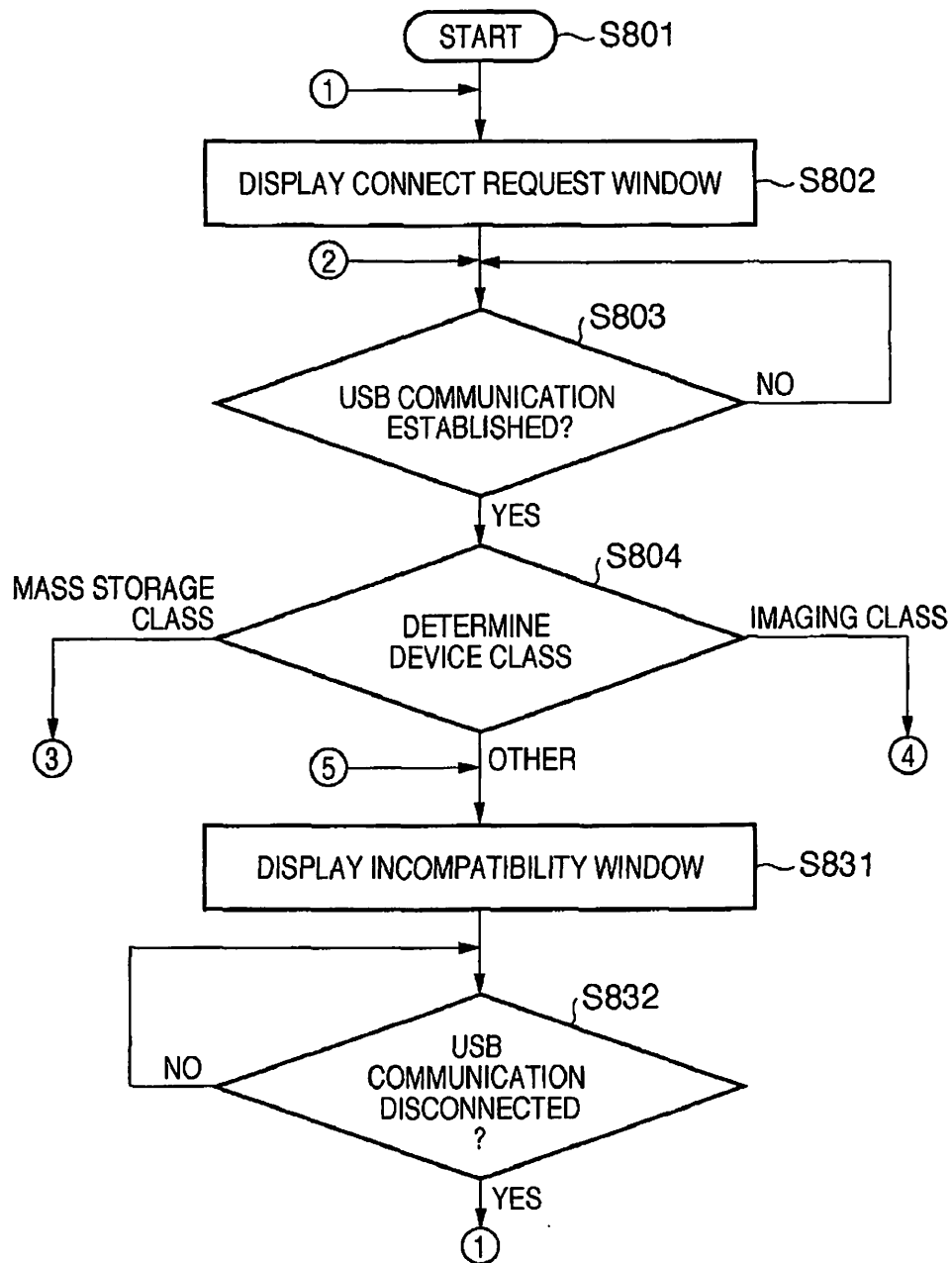


FIG. 4A

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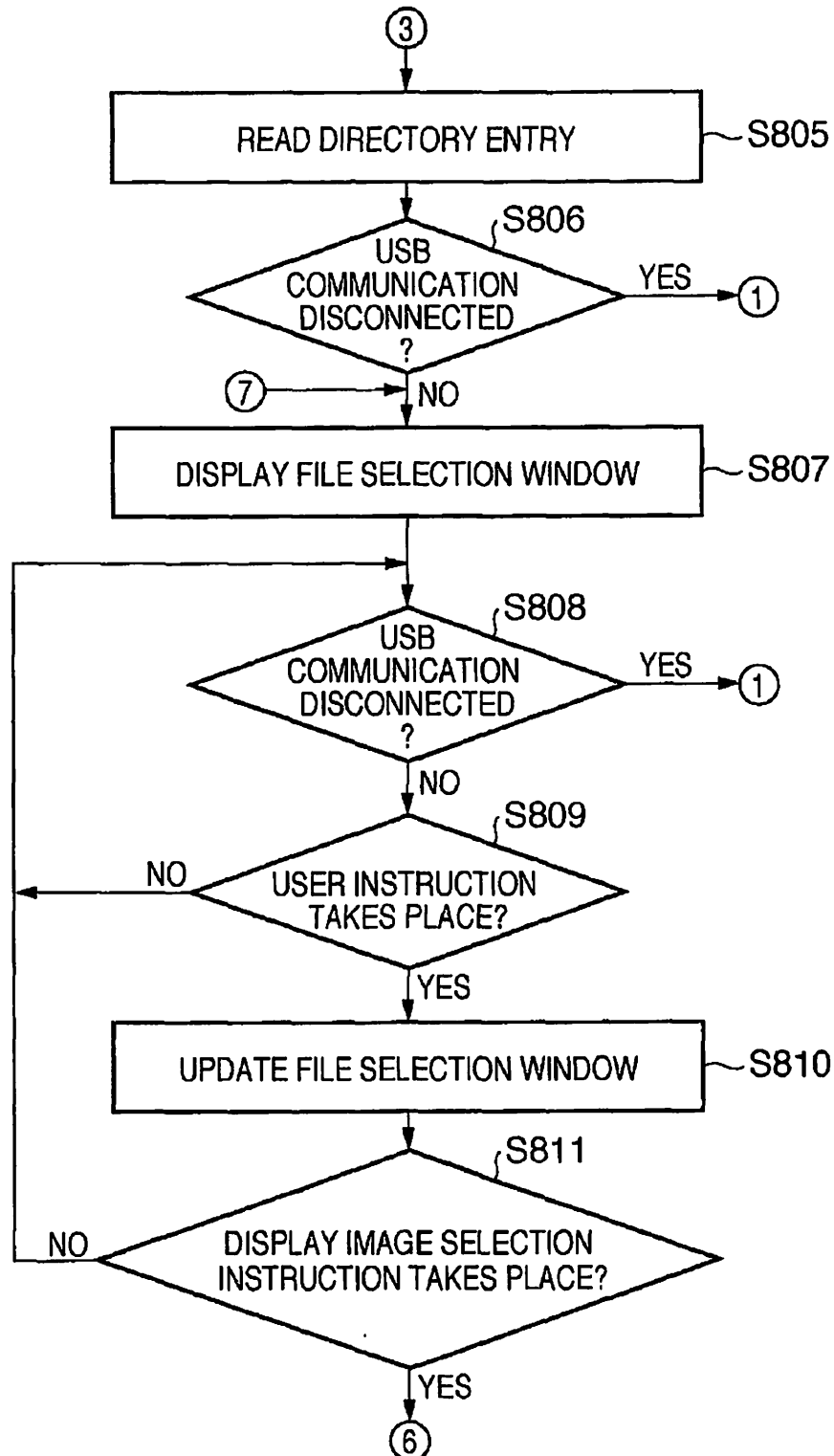
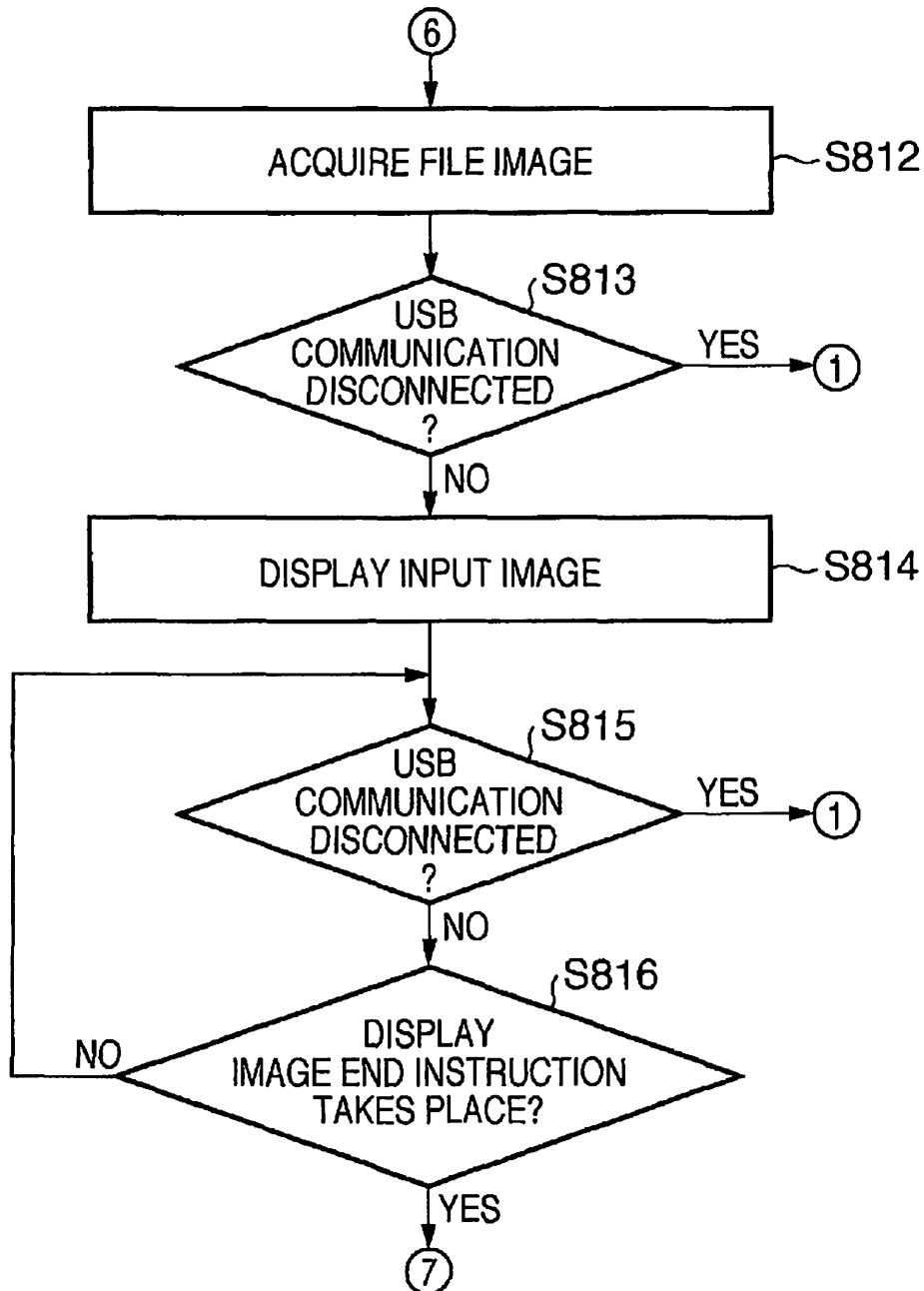
FIG. 4B-1

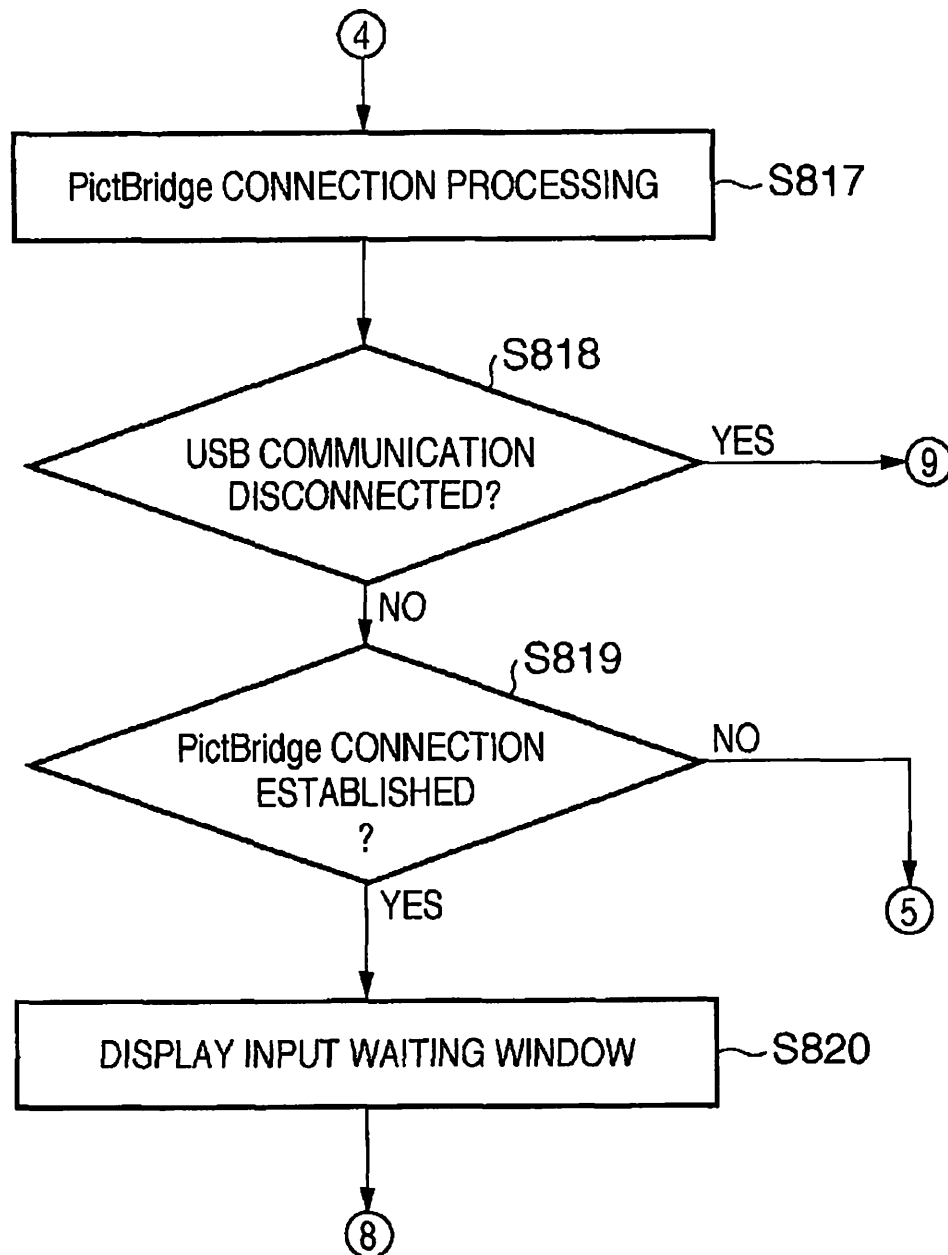
FIG. 4B-2

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FIG. 4C-1

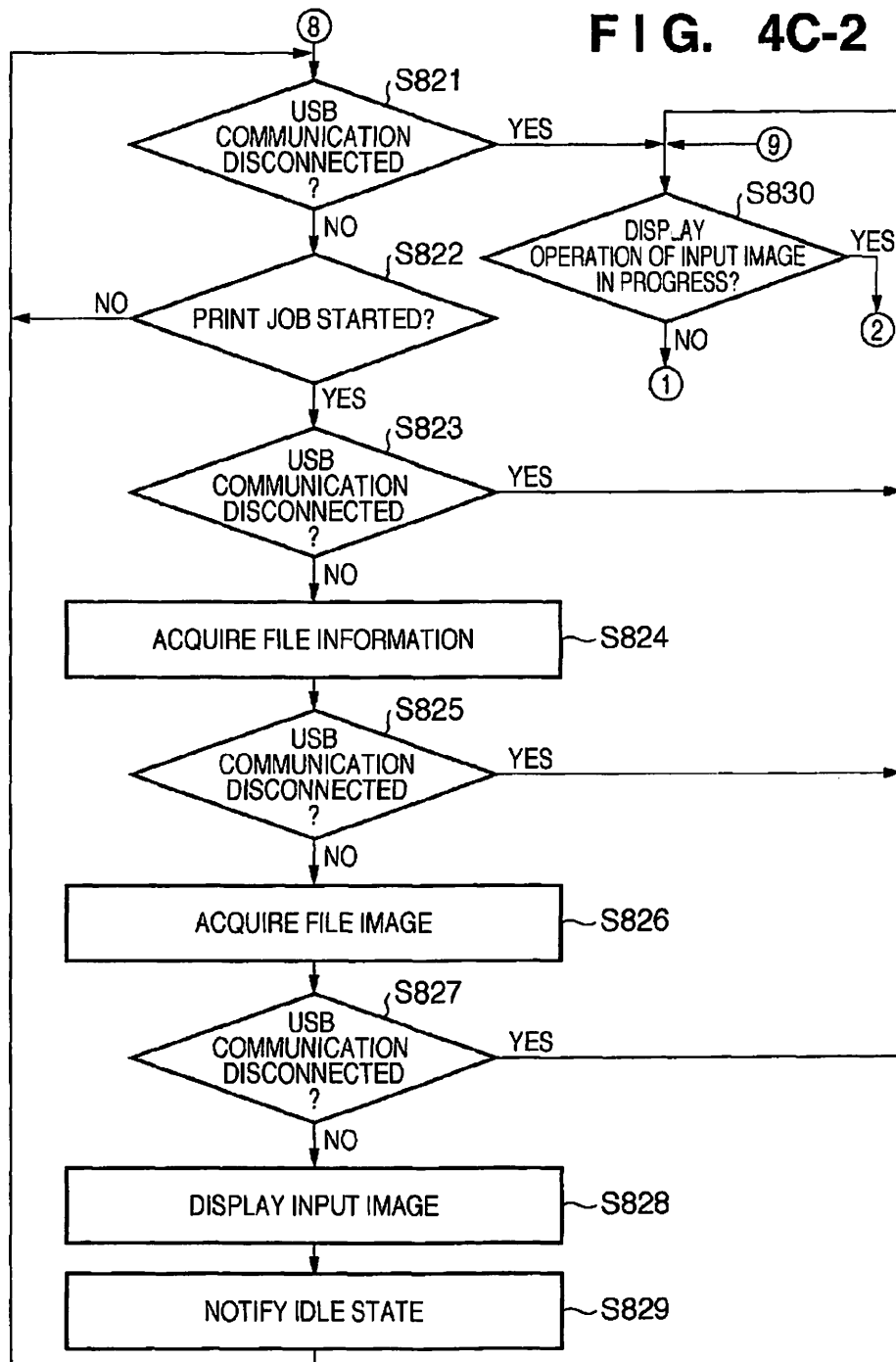
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FIG. 4C-2



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FIG. 5A

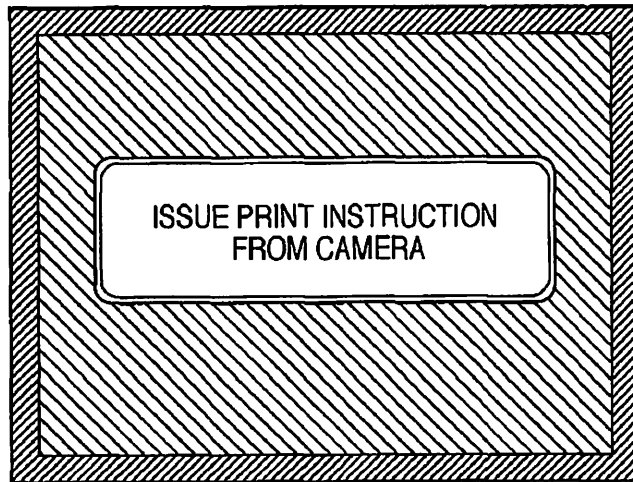


FIG. 5B

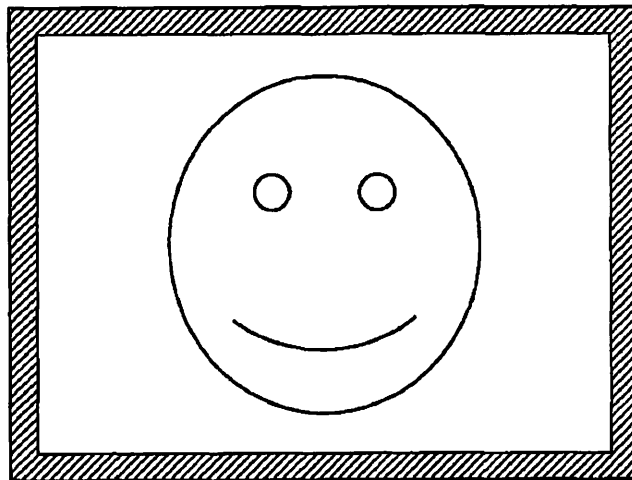


FIG. 5C

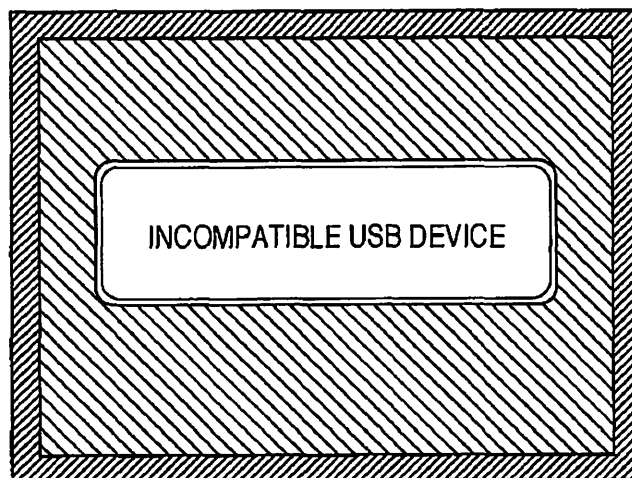
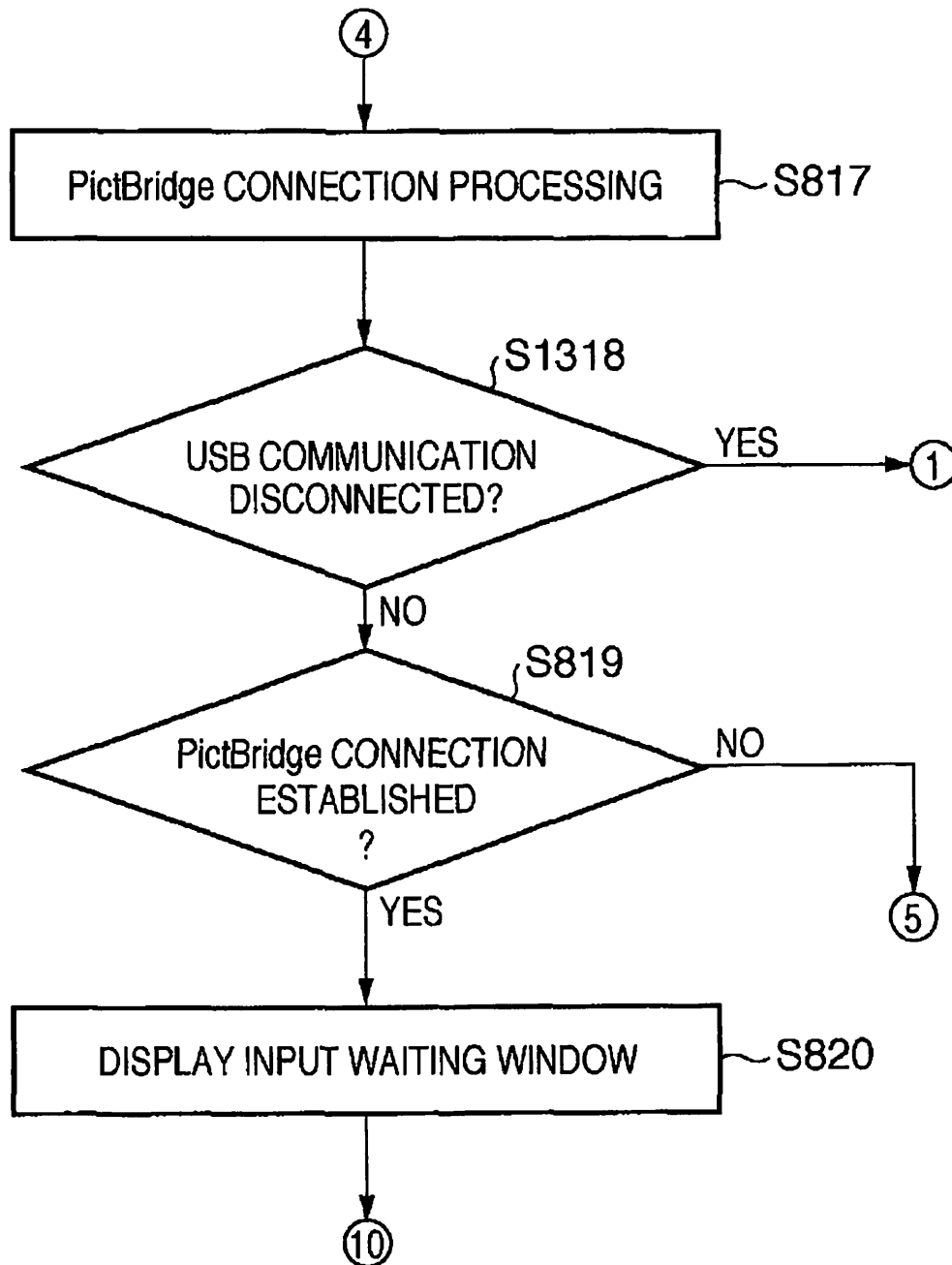


FIG. 6A

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FIG. 6B

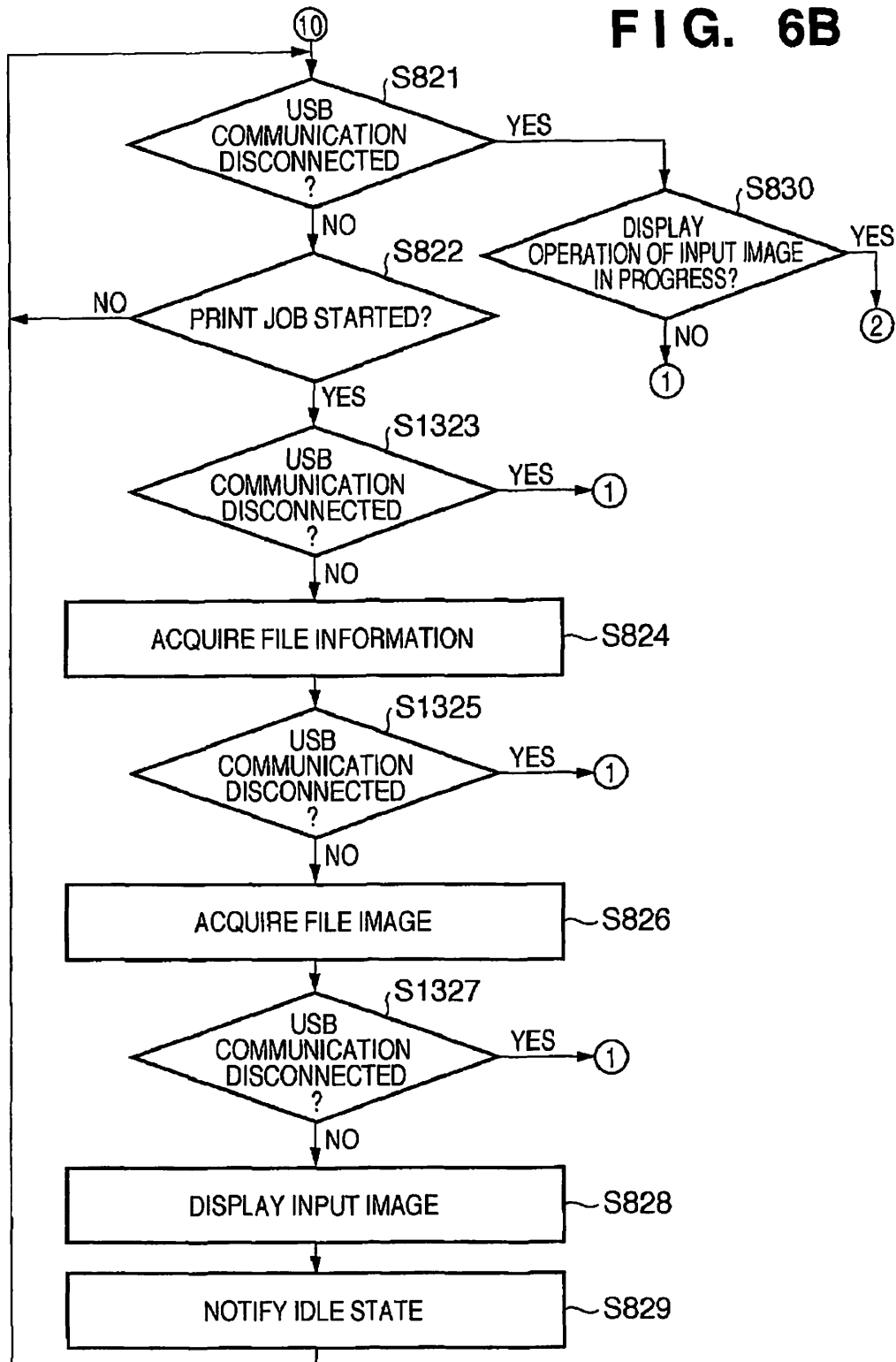


FIG. 7

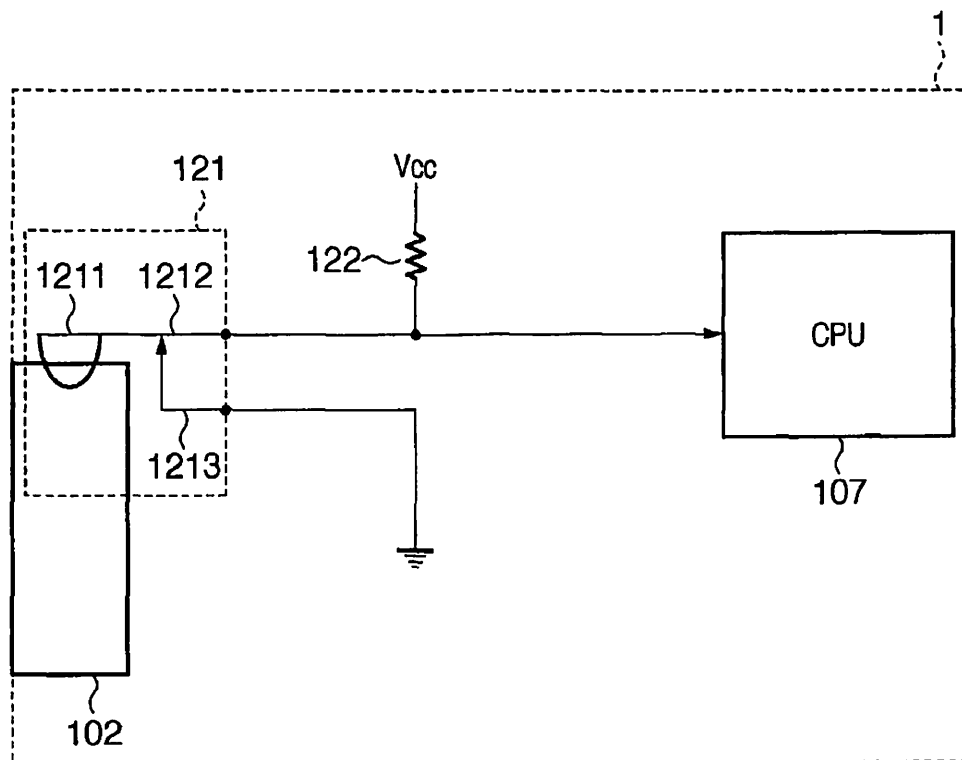
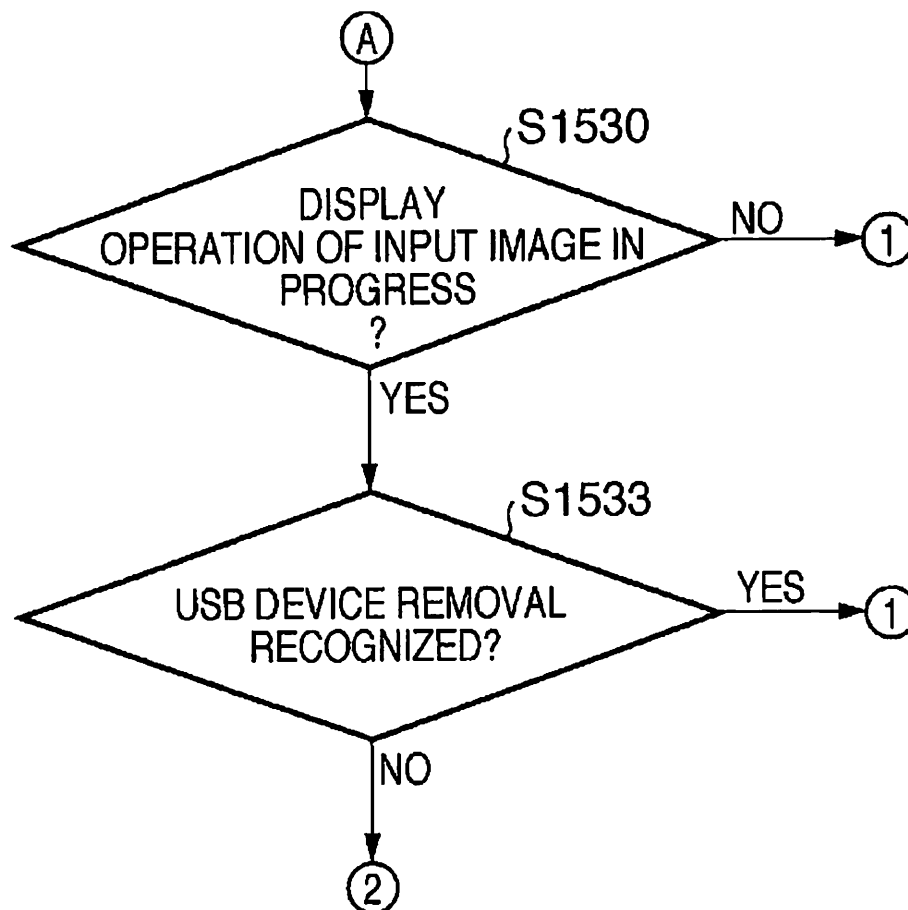


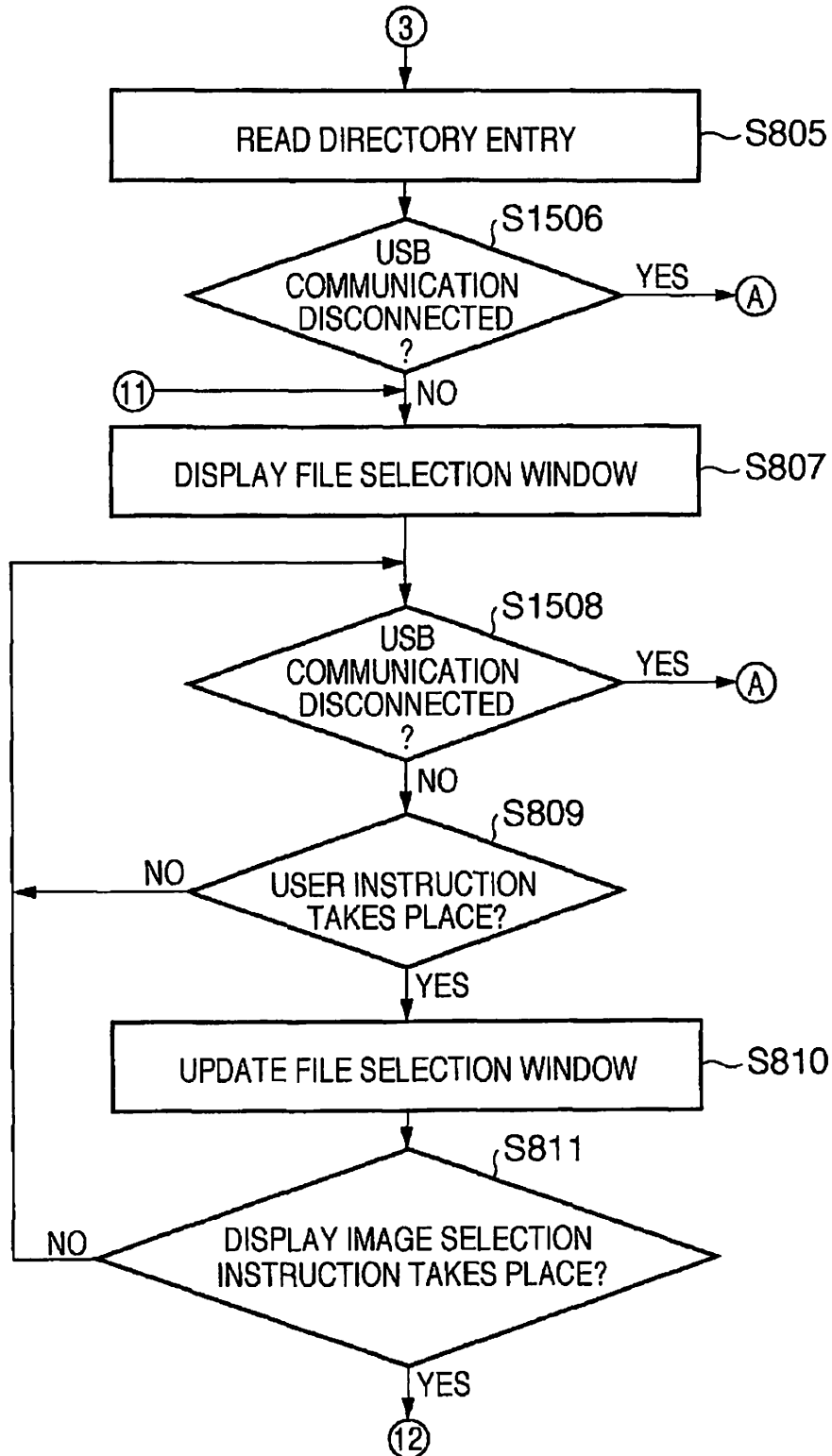
FIG. 8A

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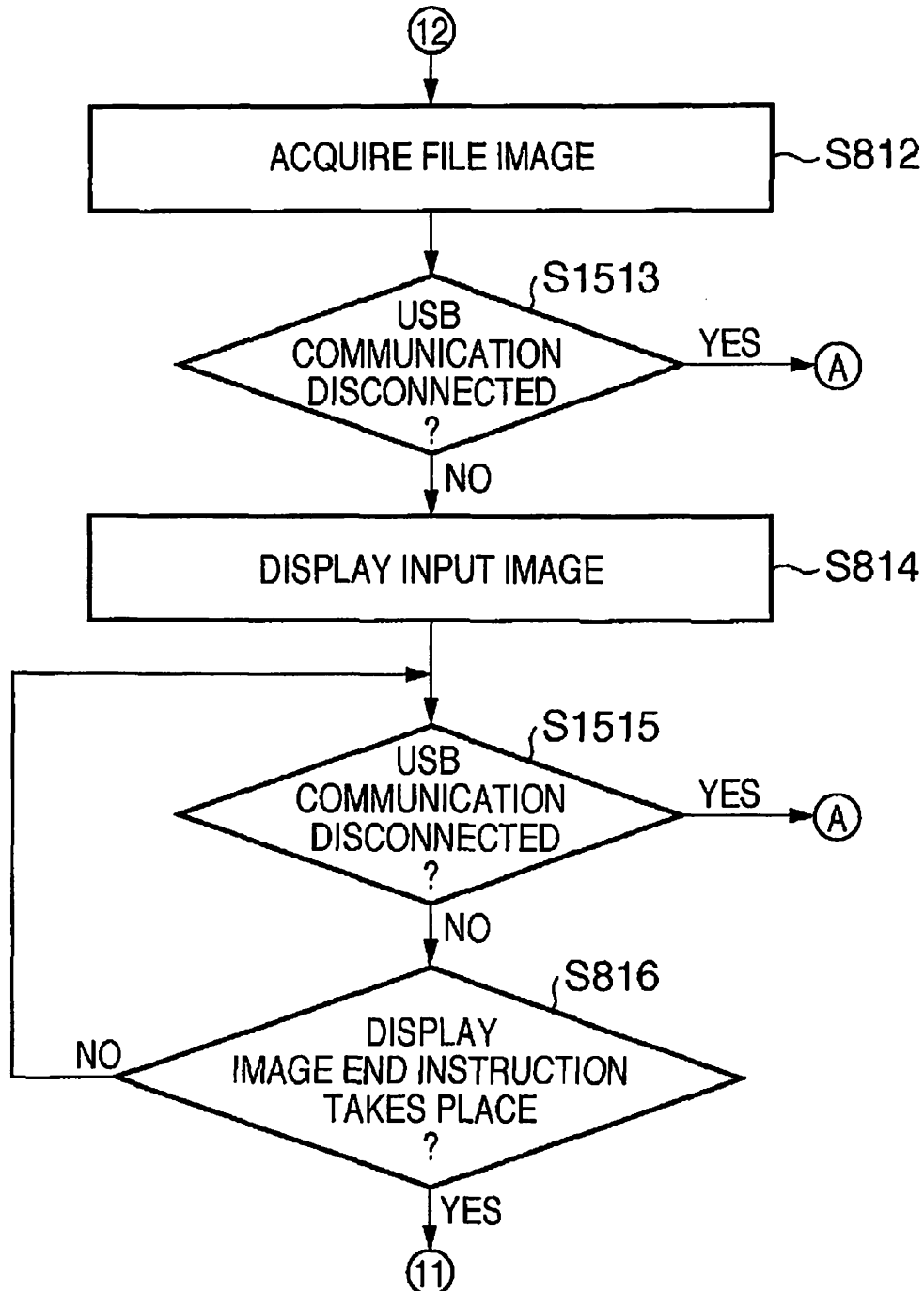
FIG. 8B-1

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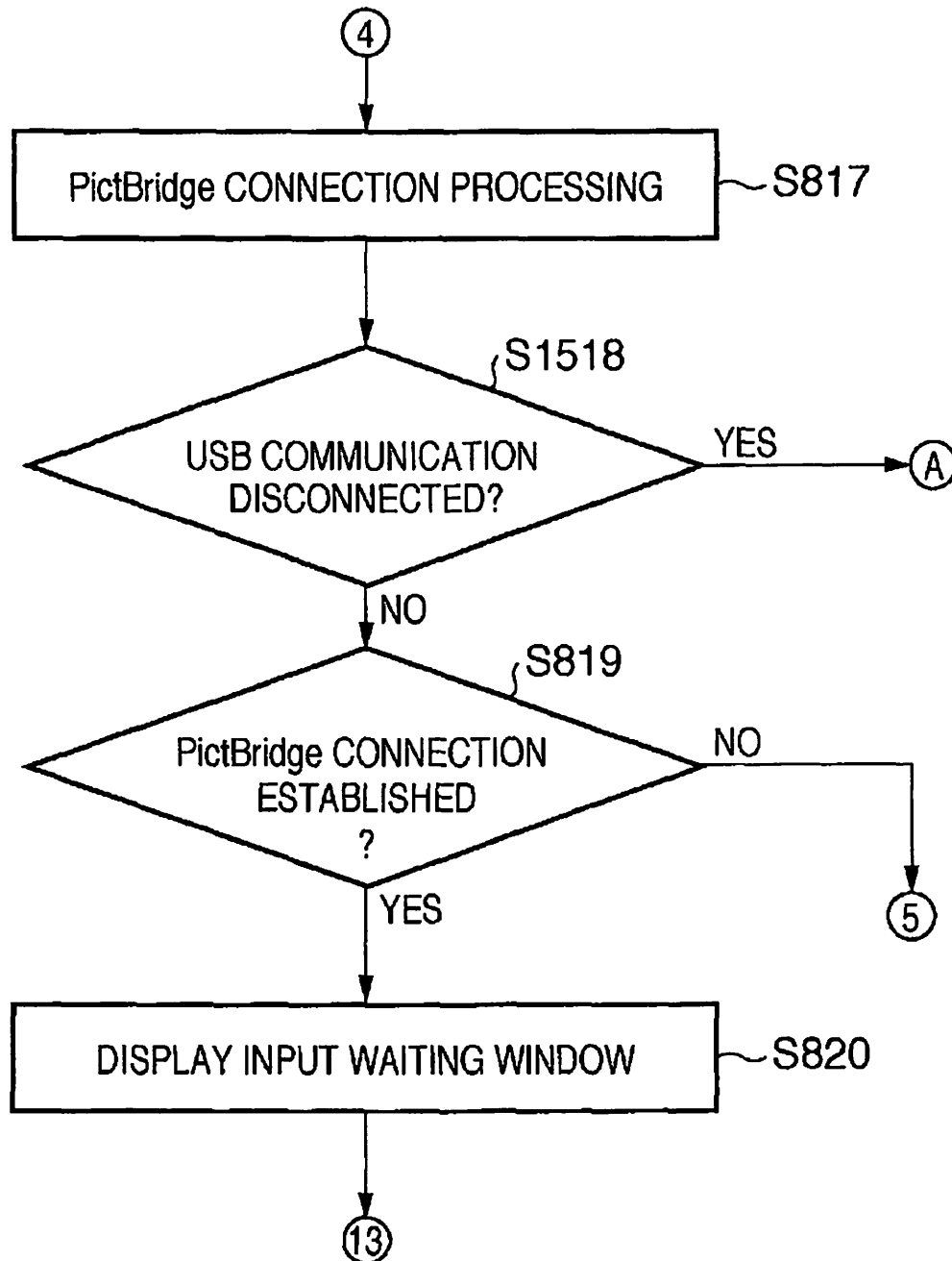
FIG. 8B-2

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FIG. 8C-1

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FIG. 8C-2

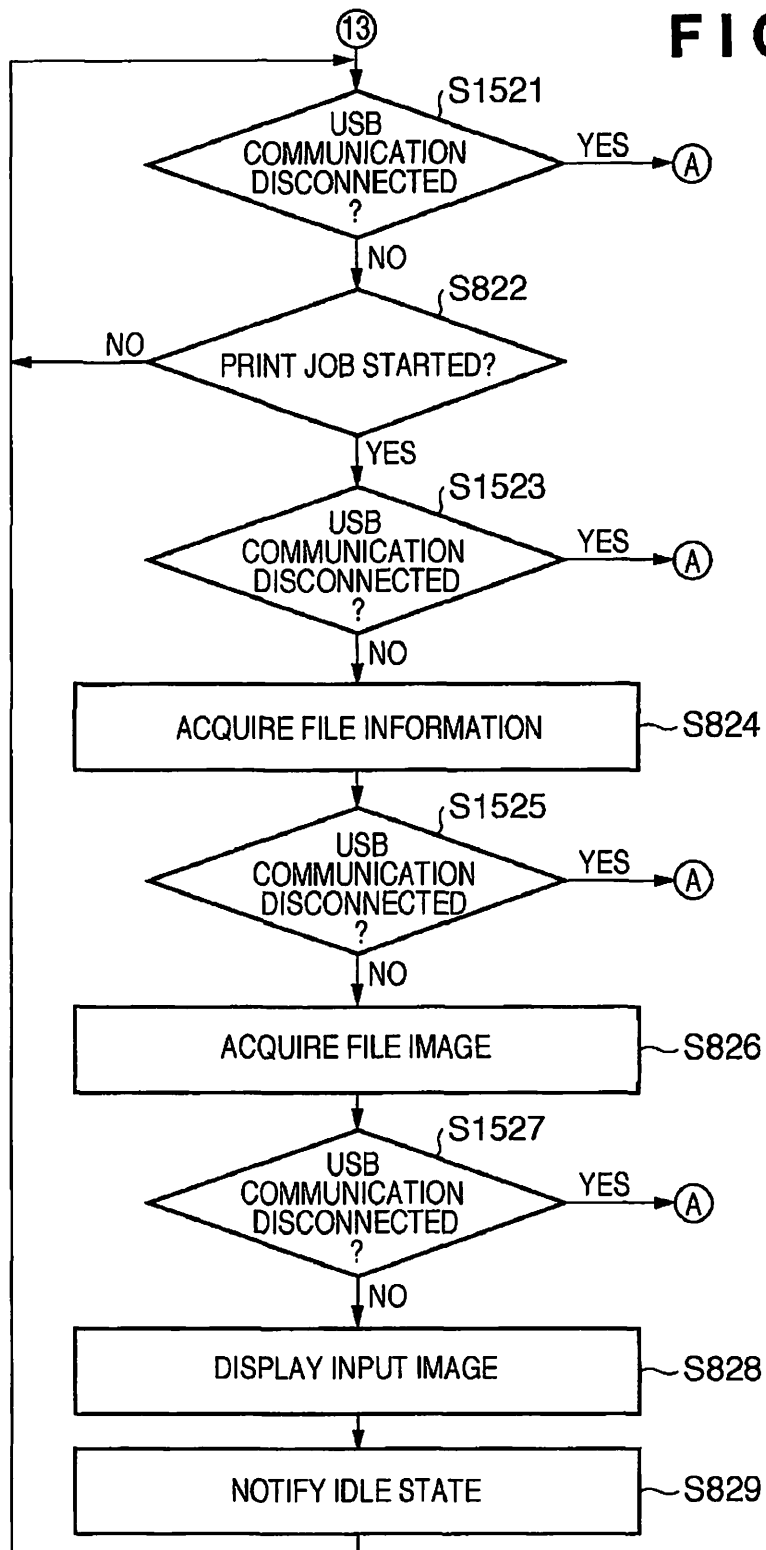
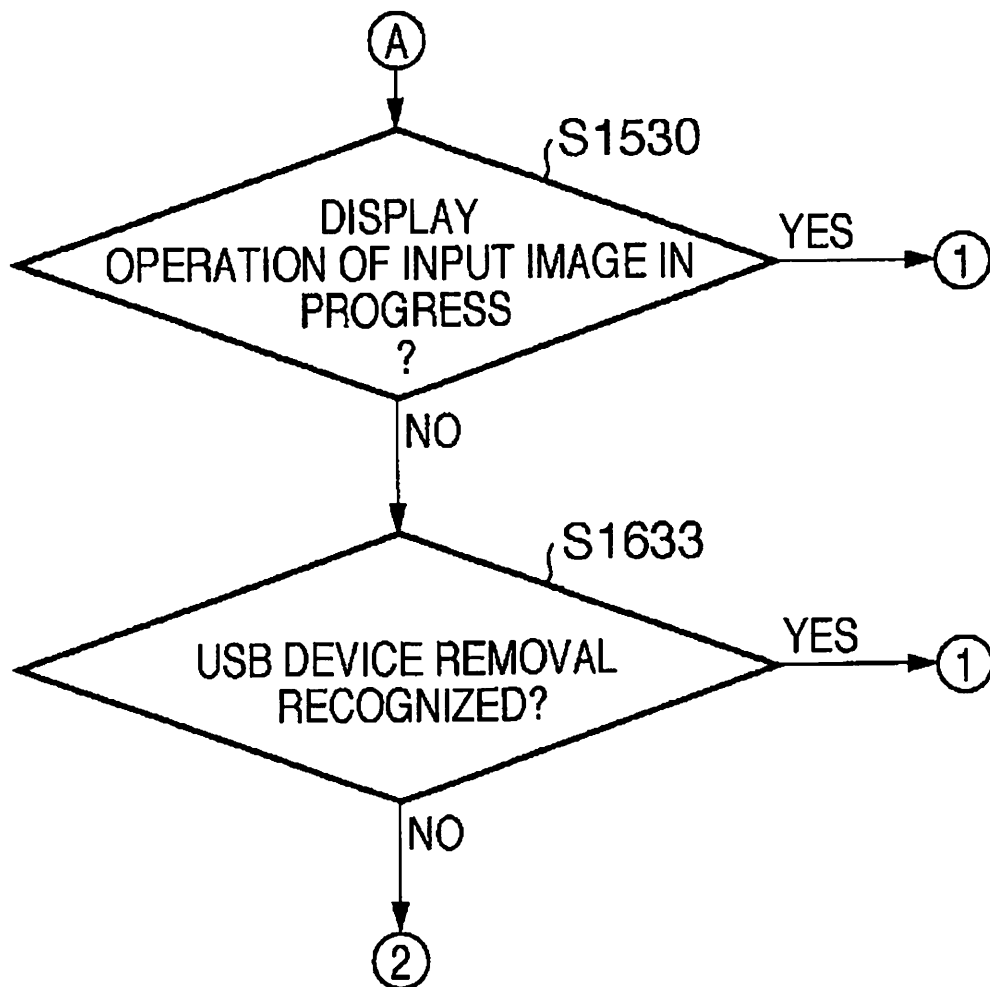


FIG. 9A



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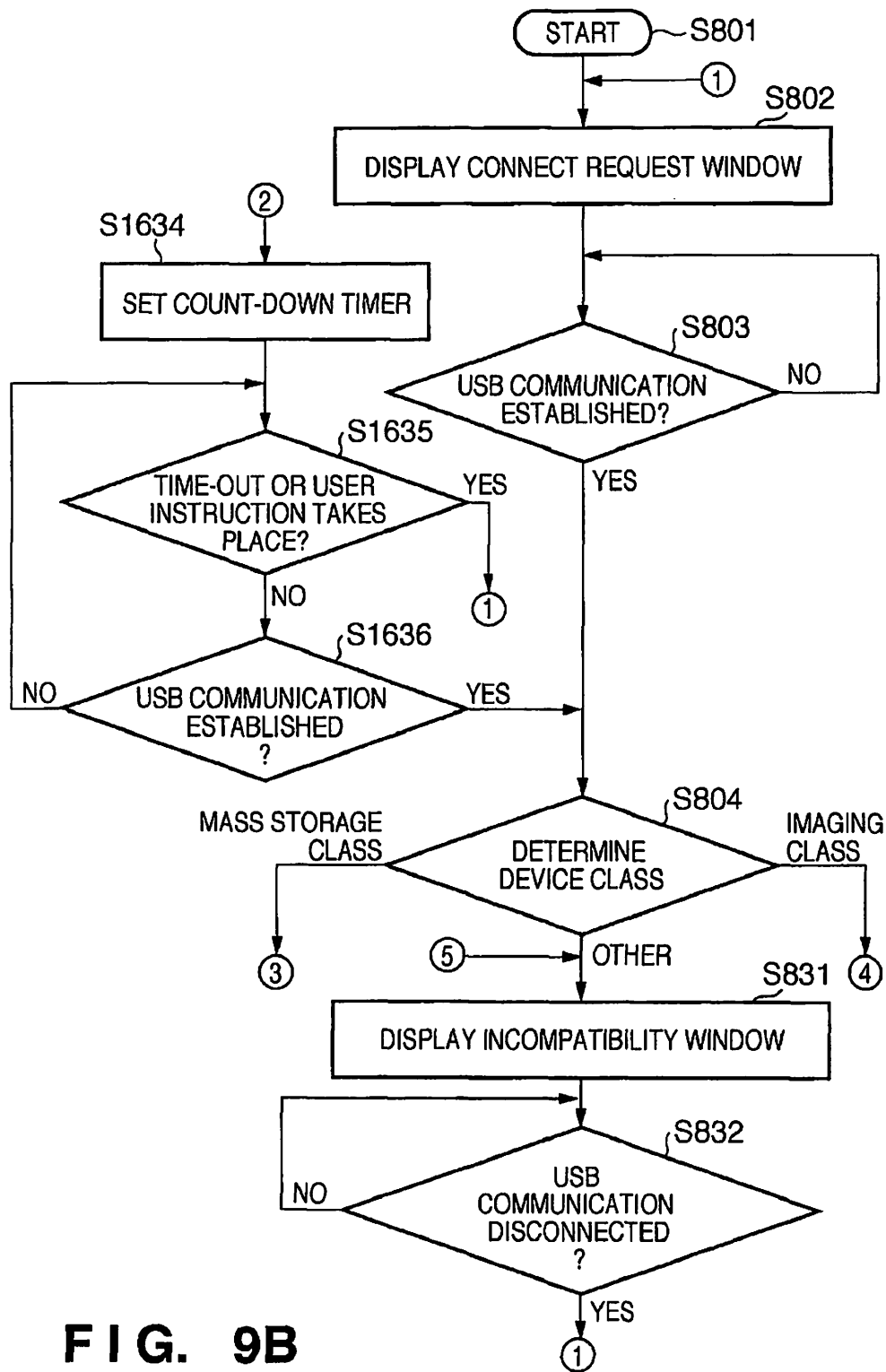
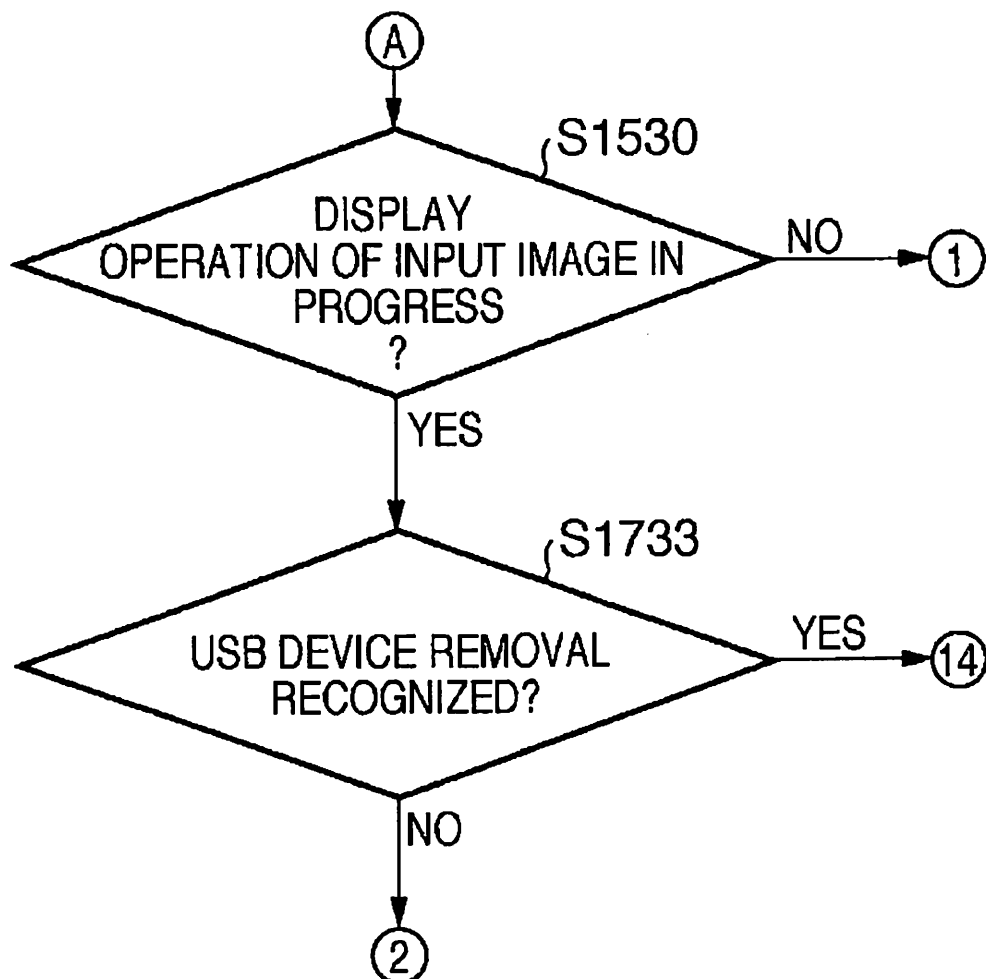


FIG. 9B

FIG. 10A



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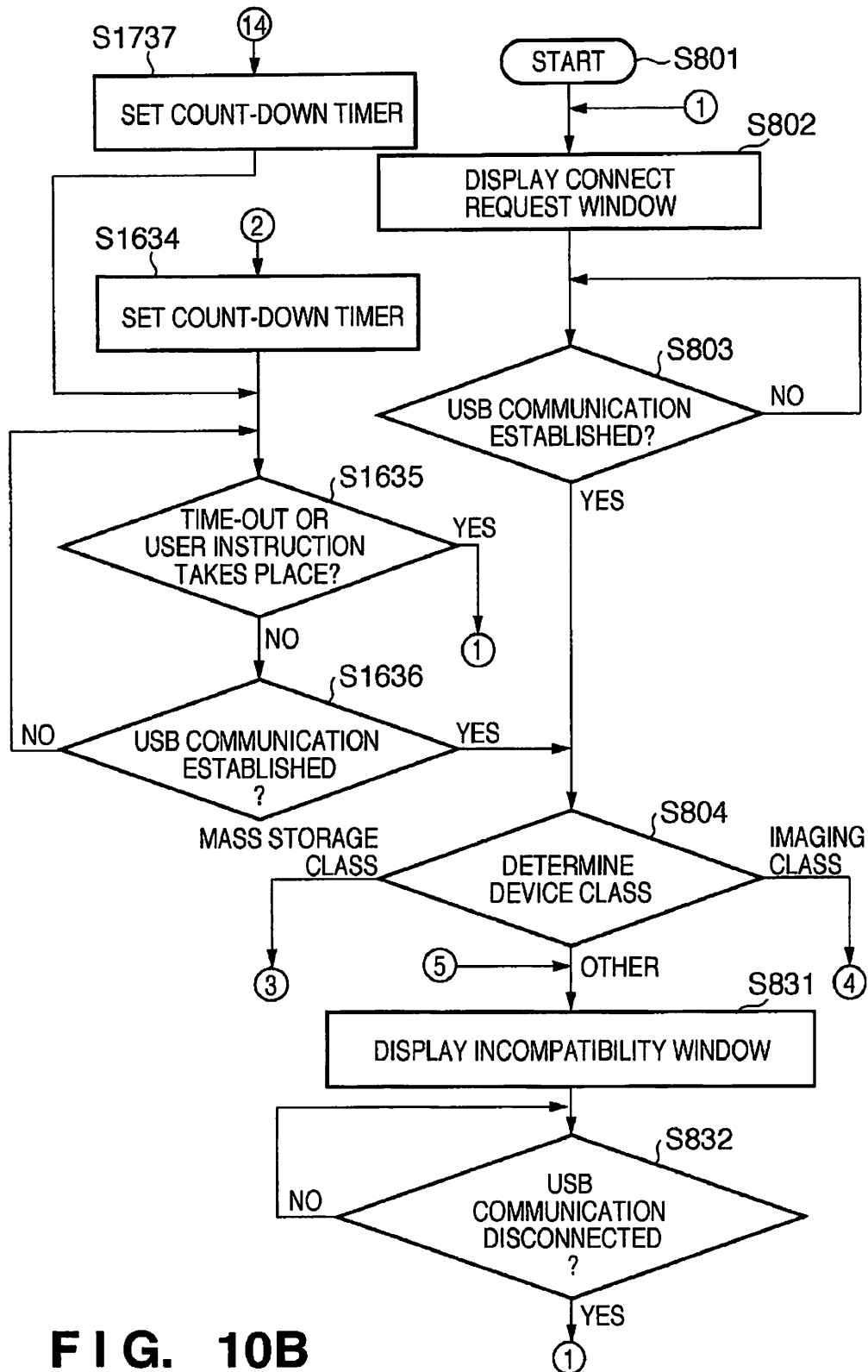


FIG. 10B

FIG. 11A

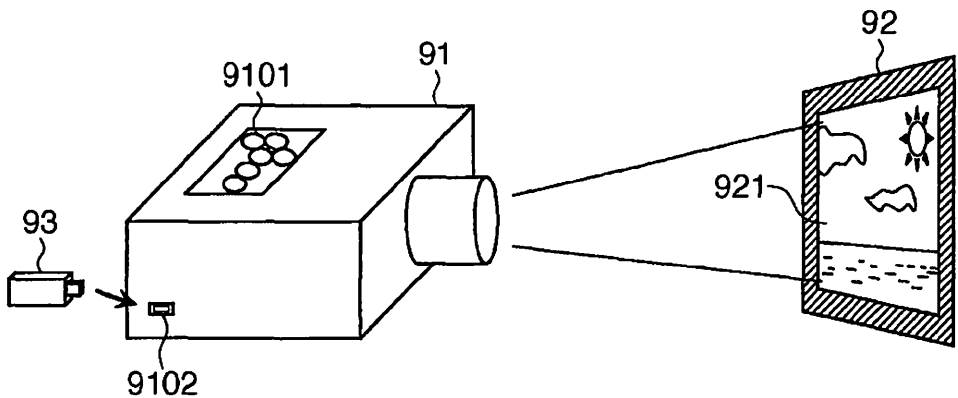
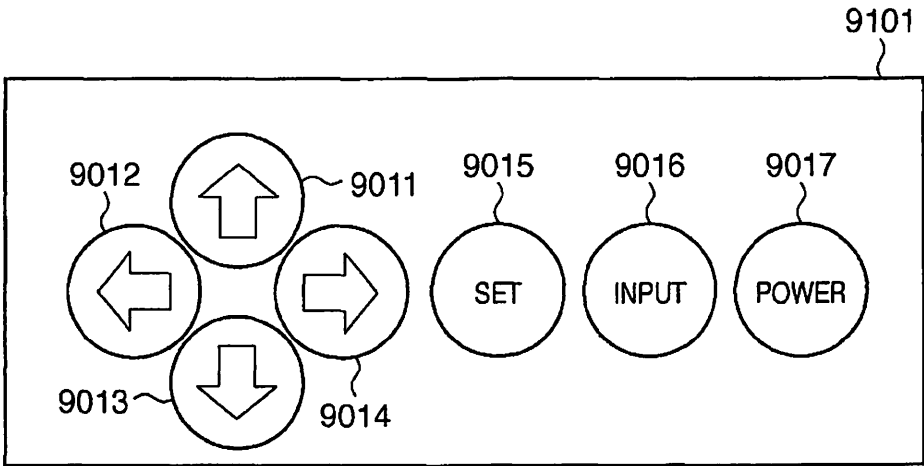


FIG. 11B



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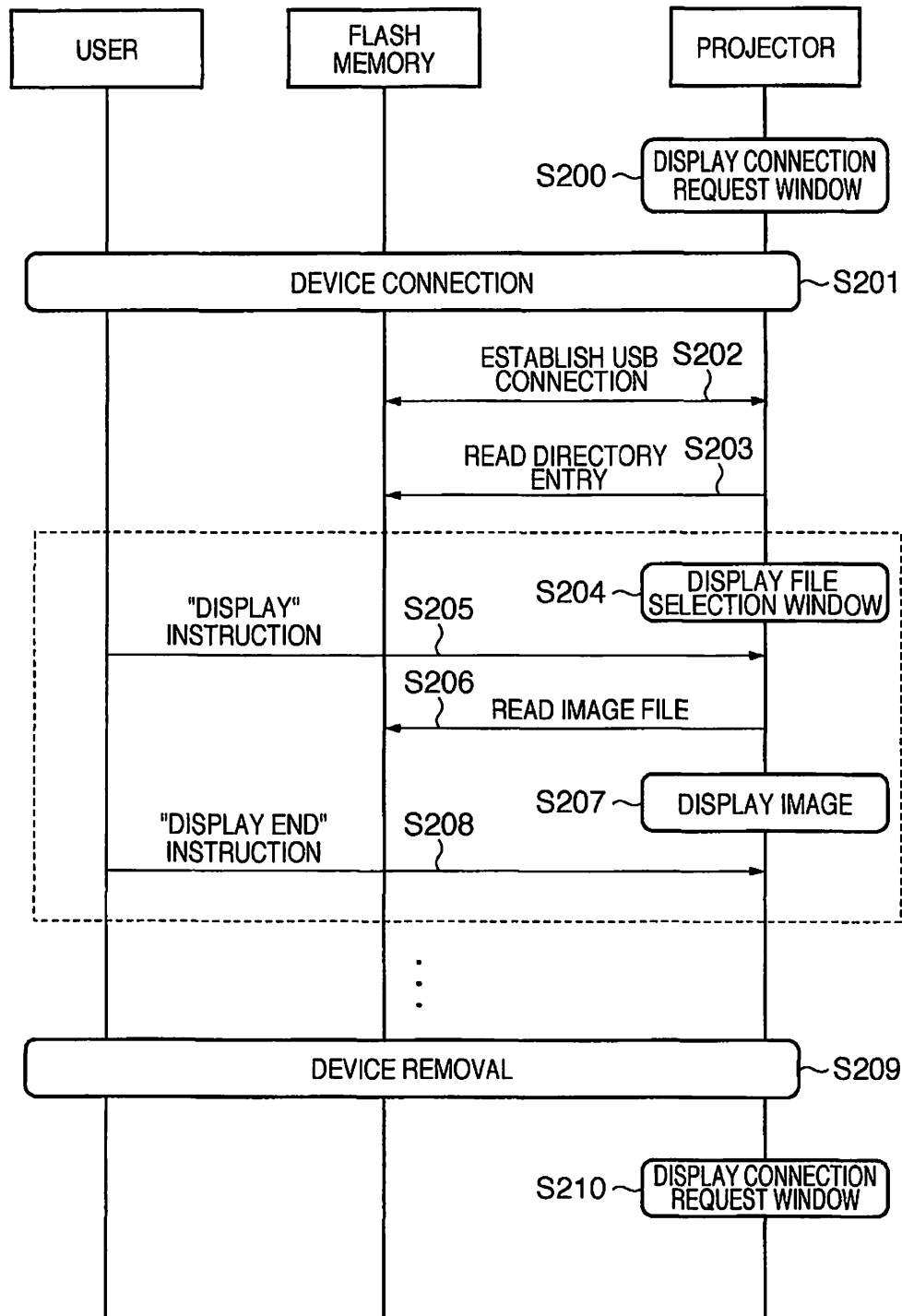
FIG. 12

FIG. 13A

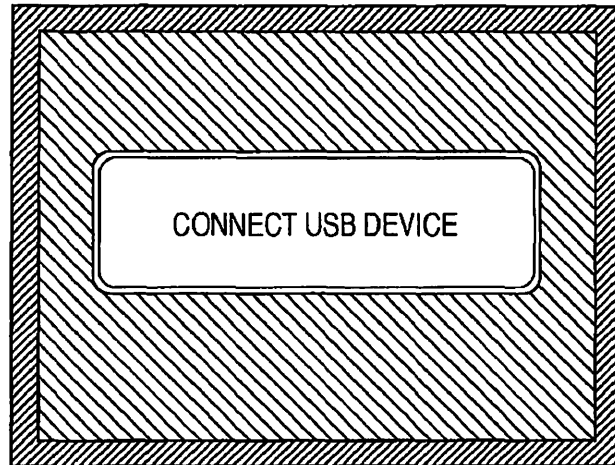


FIG. 13B

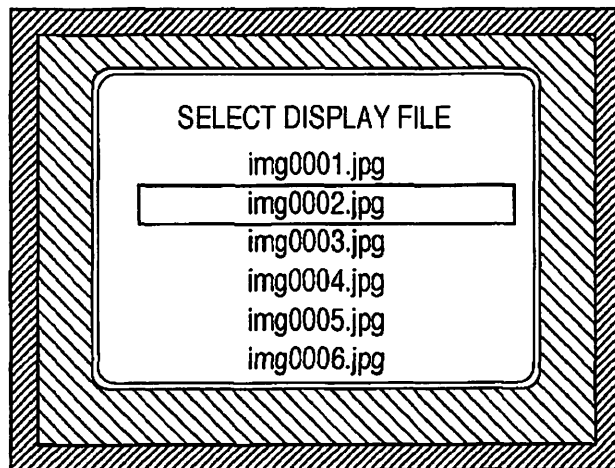
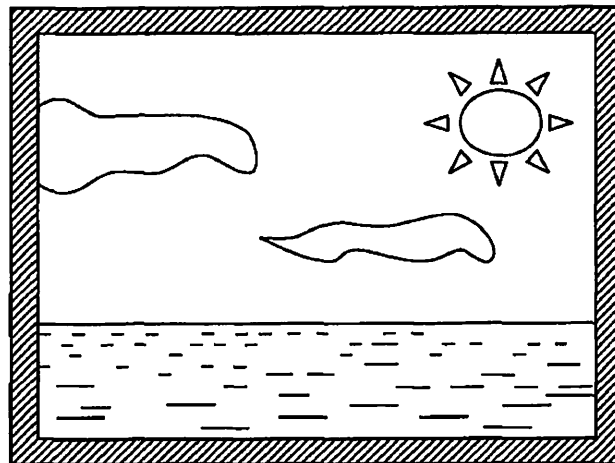


FIG. 13C



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FIG. 14A

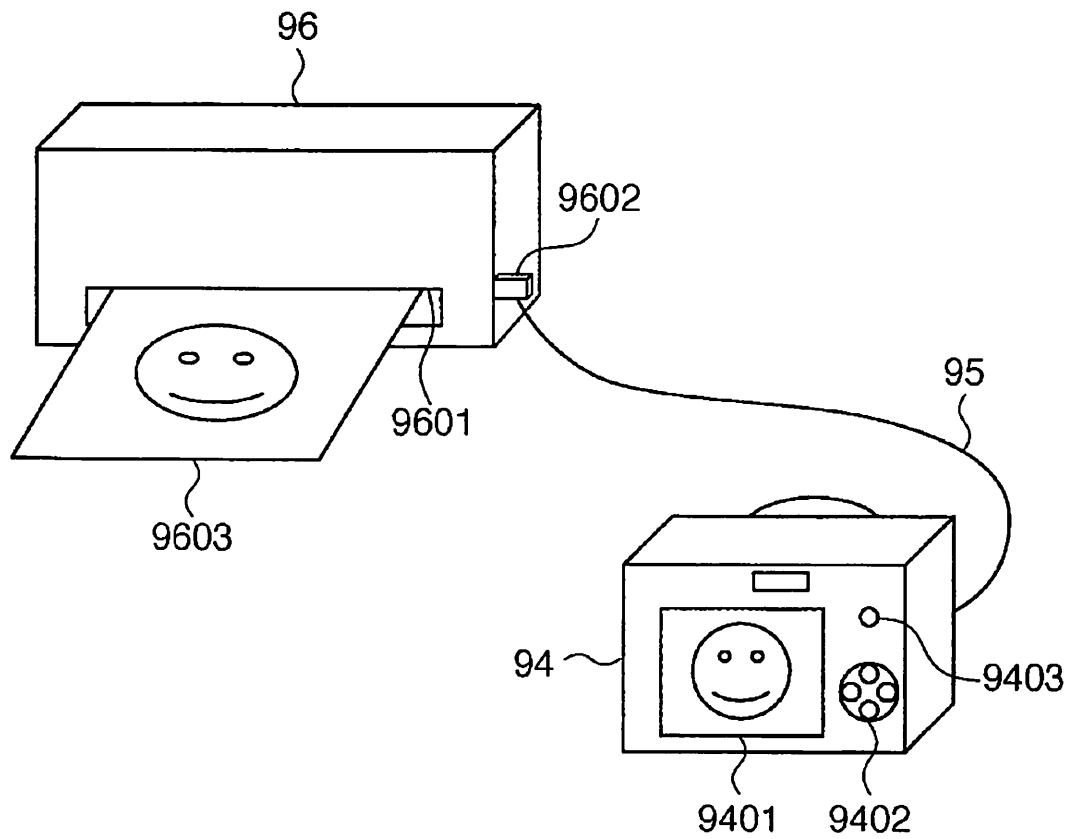
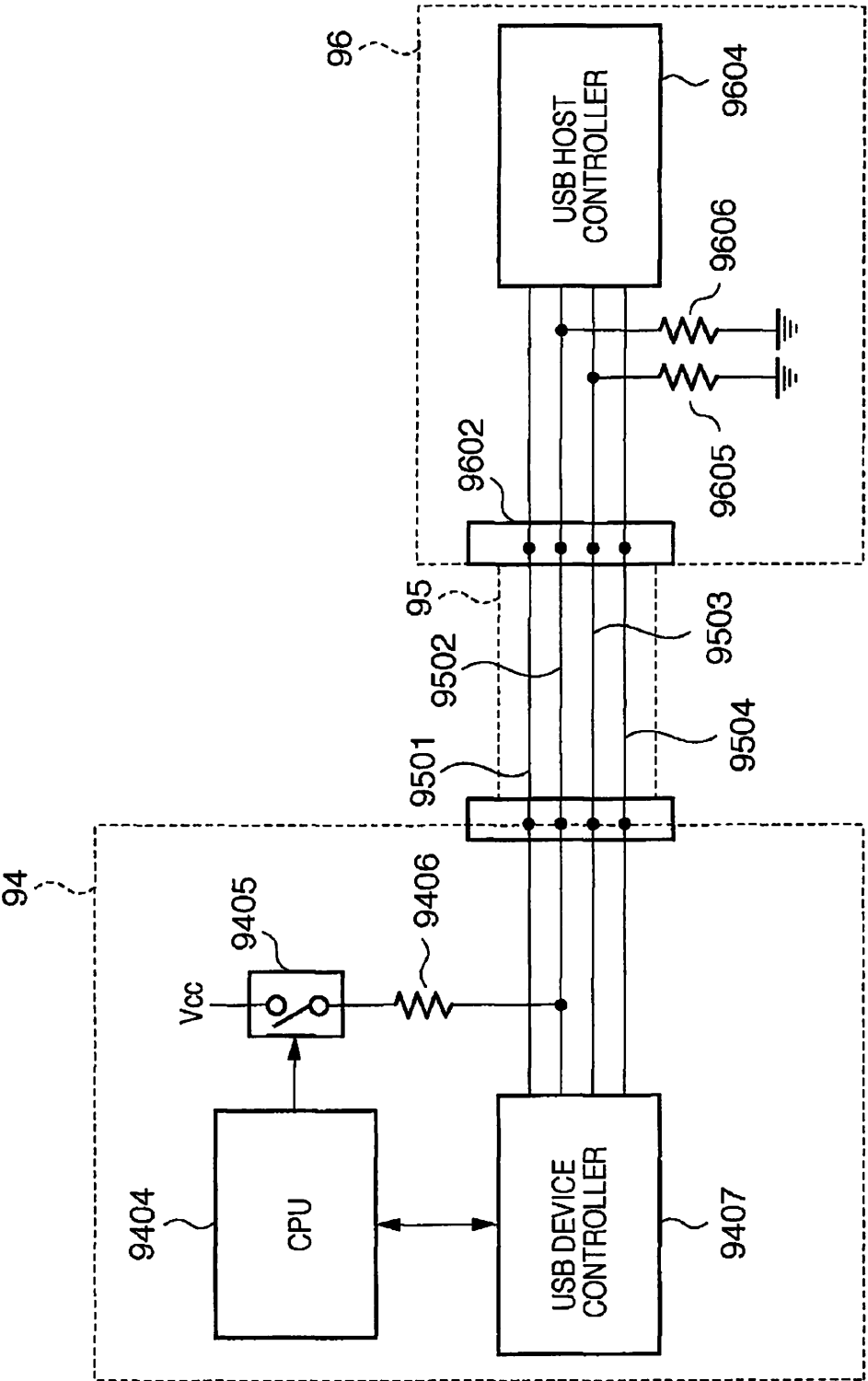


FIG. 14B



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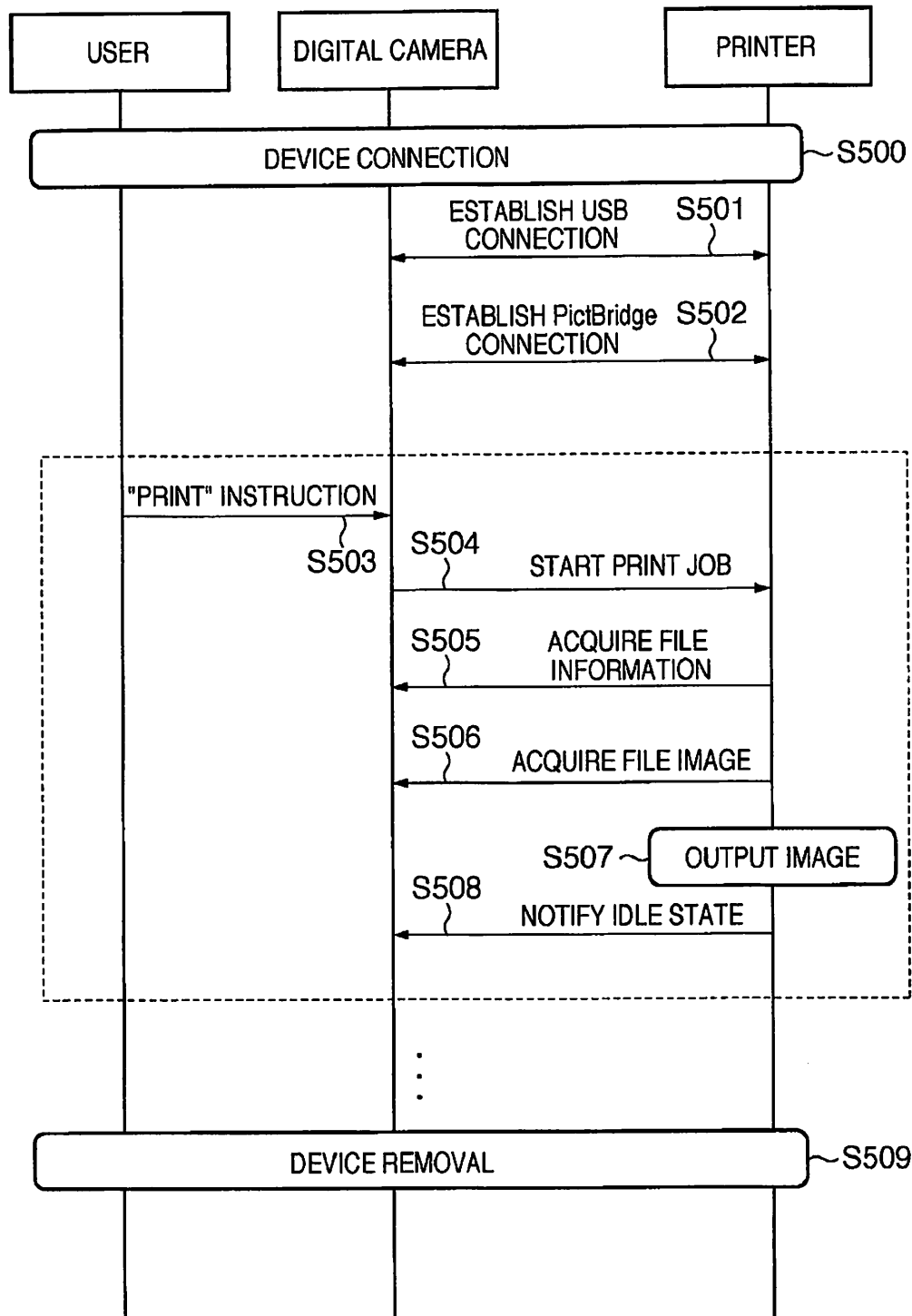
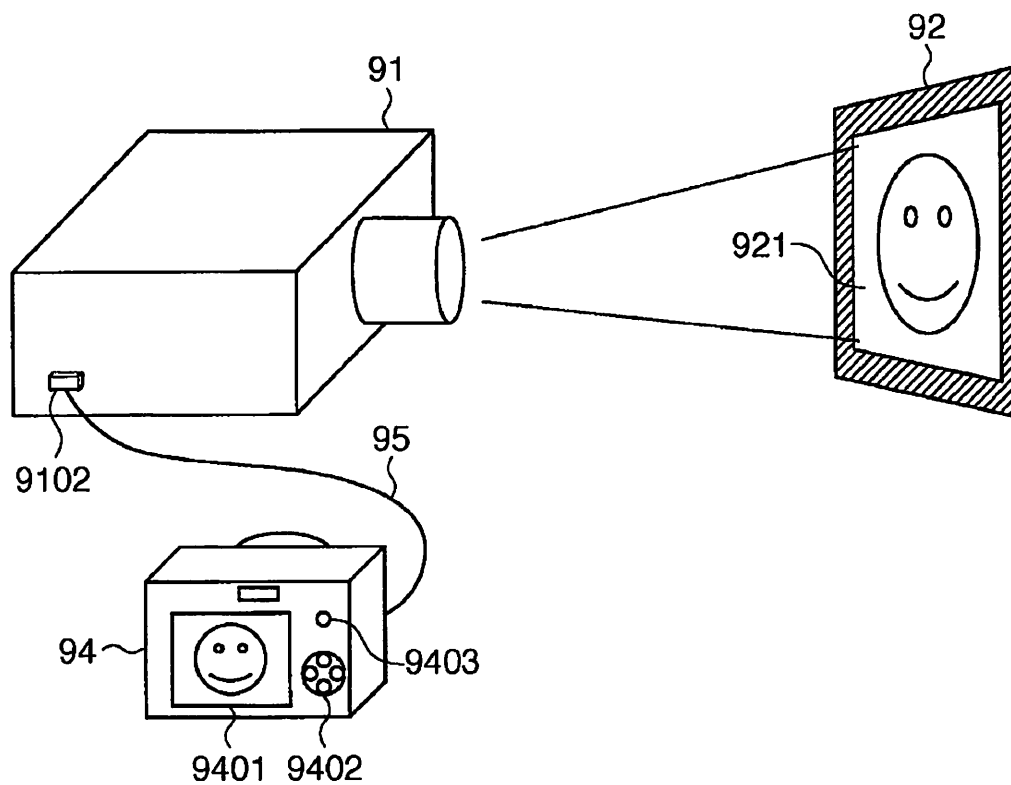
FIG. 15

FIG. 16



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**DISPLAY APPARATUS, CONTROL METHOD
THEREOF, AND PROGRAM**

This application is a continuation of PCT Application No. PCT/JP2009/055831, filed Mar. 24, 2009.

TECHNICAL FIELD

The present invention relates to a display apparatus, a control method thereof, and a program.

BACKGROUND ART

Conventionally, a display apparatus such as a projector is connected to various devices via, for example, USB (Universal Serial Bus), and displays image data transmitted from these connected devices. Various devices connected to the display apparatus include a semiconductor memory device such as a flash memory device, a PC (Personal Computer), a digital still camera (to be referred to as a "digital camera" hereinafter), and the like.

A case will be explained first with reference to FIGS. 11A to 13C wherein a flash memory as a semiconductor memory device is connected to a projector as a display apparatus, and image data stored in that flash memory is displayed on the projector. FIG. 11A is a schematic view showing an overview when a flash memory 93 is connected to a conventional projector 91 to display an image. FIG. 11B is a schematic view showing details of a control panel 9101. FIG. 12 is a sequence chart showing the operation sequence executed when the flash memory 93 is connected to the projector 91 to display an image. FIGS. 13A to 13C are schematic views exemplifying images to be projected by the projector 91 onto a screen 92.

As shown in FIG. 11A, the projector 91 has the control panel 9101 and a USB connector 9102. As shown in FIG. 11B, the control panel 9101 has an up arrow button 9011, left arrow button 9012, down arrow button 9013, right arrow button 9014, enter button 9015, input button 9016, and power button 9017. The projector 91 accepts operation instructions from the user from various buttons on the control panel 9101. The USB connector 9102 receives the flash memory 93 having a USB connection terminal. This flash memory 93 stores image data to be displayed by the projector 91. By the user plugging the flash memory 93 into the USB connector 9102 and operating the control panel 9101, he or she can browse image data stored in the flash memory 93 as an image 921 on the screen 92.

The operation sequence among the user, flash memory 93, and projector 91 will be described below. Assume that the projector 91 is powered, and the flash memory 93 is not connected to the projector 91 in an advance state. As shown in FIG. 12, the operation sequence by the user, flash memory 93, and projector 91 mainly include steps S200 to S210 which are executed in turn. In step S200, the projector 91 displays a connection request window that requests the user to connect the flash memory 93 to the USB connector 9102 by projecting that window on the screen 92. The connection request window in step S200 displays a message that prompts the user to connect the flash memory 93 as a USB device, as shown in FIG. 13A.

In step S201, the user connects the flash memory 93 to the USB connector 9102. In step S202, a USB communication is established based on the USB standard between the projector 91 and flash memory 93 which are physically connected via the USB connector 9102. In this case, the projector 91 recognizes the flash memory 93 as Mass Storage Class based on the USB standard.

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In step S203, the projector 91 reads directory entry information stored in the flash memory 93. In step S204, the projector 91 displays a file selection window that prompts the user to select an image file to be displayed by projecting that window on the screen 92. The file selection window in step S204 is as shown in FIG. 13B, and is a window that displays a file name list of image files stored in the flash memory 93, and a cursor used to select them.

In step S205, the user who confirmed the aforementioned file selection window selects an image file to be displayed by operating the control panel 9101 and issues a display instruction to the projector 91. For example, in step S205 the user gives an instruction to move the cursor by pressing the up or down arrow button 9011 or 9013 on the control panel 9101, and issues a display instruction of an image file selected by the cursor by pressing the enter button 9015.

In step S206, the projector 91 reads data of the image file designated in step S205 from the flash memory 93. In step S207, the projector 91 displays an image based on the image file read in step S206 by projecting that image on the screen 92. As the image displayed in step S207, image data of a landscape or the like captured using a digital camera is stored in advance in the flash memory 93, as shown in FIG. 13C.

In step S208, the user issues a display end instruction to the projector 91 by operating the control panel 9101. More specifically, when the user presses the enter button 9015, a display end instruction is issued to the projector 91. Note that the operations for accepting selection of an image file by the user and displaying the selected image file can be repeated by repeating steps S204 to S208 bounded by the broken line in FIG. 12.

In step S209, the user removes the flash memory 93 from the USB connector 9102. In step S210, the projector 91 clears a display image projected onto the screen 92 (or overwrites the image by a predetermined image such as a menu window) due to removal of the flash memory 93 in step S209. For example, in step S210 the connection request window shown in FIG. 13A is overwritten on an image displayed in steps S204 to S208. As a result, the projector 91 can prompt the user to connect the next device. The user removes the flash memory 93 with the intention to end browsing of image files stored in the flash memory 93. Therefore, since the projector 91 clears an image displayed in steps S204 to S208, it can attain an image display operation according to the user's intention.

Note that patent reference 1 is known as a technique of clearing (overwriting) a display image by a predetermined image in step S210 above. Patent reference 1 discloses a technique for clearing a display image at the end of a communication and a technique for clearing a previous display image at the beginning of a communication.

A case will be exemplified below wherein another example of various devices to be connected is a digital camera. Note that a case will be exemplified below with reference to FIGS. 14A and 14B, and FIG. 15 wherein a digital camera is connected to a printer, and the printer outputs an image based on image data stored in that digital camera. As a typical example in this case, the CIPA DC-001-2003 standard (to be referred to as "PictBridge" hereinafter) is available. In a method of outputting an image using this PictBridge, even a user unskilled in operations of devices such as PCs can output an image using a printer by readily operating a digital camera. An image output operation using the PictBridge will be described below.

FIG. 14A is a schematic view showing an overview when a digital camera 94 is connected to a printer 96 to output an image. FIG. 14B is a block diagram showing the arrangement

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associated with a communication between the printer 96 and digital camera 94. FIG. 15 is a sequence chart showing the operation sequence when the digital camera 94 is connected to the printer 96 to output an image.

As shown in FIG. 14A, the printer 96 has a discharge port 9601 and USB connector 9602. The discharge port 9601 discharges a paper sheet 9603 after image formation. To the USB connector 9602, the digital camera 94 is connected via a USB cable 95. The digital camera 94 has a liquid crystal panel screen 9401, operation member 9402, and PictBridge button 9403. The liquid crystal panel screen 9401 displays a preview of an image or the like transferred via the PictBridge. The operation member 9402 accepts an image selection instruction from the user. The PictBridge button 9403 is a button which accepts an instruction to start PictBridge transfer from the user. An image based on image data stored in the digital camera 94 is output onto a paper sheet in the printer 96 in such a manner that an image output instruction is output to the printer 96 by an operation on the digital camera 94 side, and image data to be output is transmitted from the digital camera 94 to the printer 96.

The operation sequence among the user, digital camera 94, and printer 96 will be described below. As shown in FIG. 15, the operation sequence by the user, digital camera 94, and printer 96 mainly includes steps S500 to S509, which are executed in turn. In step S500, the user connects the digital camera 94 and printer 96 via the USB cable 95. In step S501, a USB communication is established based on the USB standard between the digital camera 94 and printer 96 which are physically connected via the USB cable 95. In this case, the printer 96 recognizes the digital camera 94 as a capture device of Imaging Class based on the USB standard.

In step S502, a PictBridge connection is established between the digital camera 94 and printer 96. More specifically, a connection is established in a PTP (Picture Transfer Protocol) layer, device information is exchanged, and so forth. Then, a communication state as a PictBridge sequence transits to an idle state, and the printer 96 waits for issuance of a print job by the digital camera 94.

In step S503, the user issues a print instruction via the PictBridge by operating the digital camera 94. More specifically, this print instruction in step S503 is issued when the user presses the PictBridge button 9403. In step S504, the digital camera 94 transmits a PictBridge print job to the printer 96 based on the print instruction in step S503, and the printer 96 starts the operation of that print job.

In step S505, the printer 96 requests the digital camera 94 to transmit file information to be printed in accordance with the print job in step S504, and acquires that file information. Likewise, in step S506 the printer 96 requests the digital camera 94 to transmit a file image (image data) to be printed in accordance with the print job in step S504, and acquires that file image.

In step S507, the printer 96 executes decoding, scaling, print processing, and the like of an image indicated by the file acquired in steps S505 and S506, and outputs the paper sheet 9603 after image formation from the discharge port 9601. In step S508, the printer 96 notifies the digital camera 94 of an idle state upon completion of the print job. Note that the operations for accepting selection of an image to be printed from the user, and printing out the selected image can be repeated by repeating steps S503 to S508 bounded by the broken line in FIG. 15.

In step S509, the user removes the USB cable 95 from the printer 96 or digital camera 94. Note that a device, which can control a communication session and logically disconnects a communication connection like the digital camera 94, often

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disconnects a communication like closing of a communication session in addition to a physical communication disconnection by, for example, removal of the USB cable 95. For example, when the battery remaining amount lowers during the aforementioned PictBridge sequence, the digital camera 94 side may execute control for disconnecting a USB communication so as to reduce consumption power.

A communication disconnection on the digital camera 94 side will be explained below by exemplifying the arrangement associated with a communication between the digital camera 94 and printer 96. As shown in FIG. 14B, a USB host controller 9604 on the printer 96 side is connected to a USB device controller 9407 on the digital camera 94 side via the USB cable 95. The USB cable 95 includes four signal lines, that is, a VBUS line 9501, D+ line 9502, D- line 9503, and GND line 9504.

The D+ line 9502 and D- line 9503 are used to transmit differential signals required to make a USB data communication, and also indicate a device connection state by a voltage in a steady state. The D+ line 9502 and D- line 9503 are respectively pulled down by resistors 9606 and 9605 on the printer 96 side, and indicate a Low voltage when no USB cable is connected. Thus, the printer 96 recognizes a USB non-connection state. On the other hand, when the printer 96 and digital camera 94 are connected, the D+ line 9502 is pulled up by a resistor 9406 via a switch 9405 on the digital camera 94 side. Then, when the switch 9405 is in a connection state, the D+ line 9502 indicates a High voltage. As a result, the printer 96 recognizes a USB connection state.

A CPU 9404 controls the switch 9405 on the digital camera 94 side. Note that the CPU 9404 executes the following processing for the purpose of, for example, reducing consumption power of the digital camera 94. For example, in step S508 in which the PictBridge sequence transits to an idle state upon completion of the print job, the CPU 9404 controls the switch 9405 on the digital camera 94 side to stop to pull up the D+ line 9502. In this case, the D+ line 9502 indicates a Low voltage since it is pulled down on the printer 96 side. For this reason, the USB host controller 9604 recognizes a USB non-connection state and disconnects a USB communication, since this state is electrically equivalent to cable removal in association with the D+ line 9502. That is, the communication session between the digital camera 94 and printer 96 is closed by the control on the digital camera 94 side for the purpose of, for example, reducing consumption power.

When a communication disconnection is made on the digital camera 94 side, as described above, the user meets the same behavior as that when the USB cable 95 is removed at the end of the print processing of the printer 96. That is, the PictBridge sequence reaches the same state as that when the process reaches step S509.

Note that the PictBridge that assumes printing has been exemplified, but the PictBridge is applicable to a display on a display apparatus such as a projector or television. For example, when the digital camera 94 is connected to the projector 91 to display an image, as shown in FIG. 16, the PictBridge allows the projector 91 to project and display an image transmitted from the digital camera 94 by a simple operation on the digital camera 94 side. Like in the case in which the printer 96 and digital camera 94 are connected, when a communication is disconnected on the digital camera 94 side, the user meets the same behavior as that when the USB cable 95 is removed. That is, the projector 91 clears an image which was transmitted from the digital camera 94 and was displayed immediately before the communication disconnection by displaying, for example, the connection request window.

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As a technique for disconnecting a USB communication from the device side, patent reference 2 is known. Patent reference 2 discloses a technique for disconnecting a communication by stopping to pull up a data line on the device side based on a disconnection instruction from the host side. Patent Reference 1: Japanese Patent Laid-Open No. 7-123379
Patent Reference 2: Japanese Patent Laid-Open No. 2006-235993

DISCLOSURE OF THE INVENTION

Problems that the Invention is to Solve

As described above, the conventional display apparatus can be connected to various devices, and can display image data stored in a connected device. However, independently of the device class to be connected, when a communication is disconnected, the display operation of an image transmitted from that device ends. For this reason, in addition to the image display end operation that the user intended by removing the flash memory or USB cable, the image display operation often ends without the intention of the user by the control on the device side that logically disconnects a communication connection.

The present invention handles at least one of such conventional problems. That is, the present invention provides a display apparatus, which can control to continue or end a display operation according to a device class when a communication connection with a device is disconnected during execution of the display operation based on data transmitted from the connected device, a control method thereof, and a program.

Means of Solving the Problems

According to the first invention of the present application, there is provided a display apparatus characterized by comprising a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, characterized in that the control unit acquires class information indicating a class of the external device from the external device via the connection unit, controls the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the second invention of the present application, there is provided a control method of a display apparatus which comprises a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, the method characterized by comprising the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

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play unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the third invention of the present application, there is provided a display apparatus characterized by comprising a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, characterized in that the control unit acquires class information indicating a class of the external device from the external device via the connection unit, controls the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is the predetermined class, and controls the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the fourth invention of the present application, there is provided a control method of a display apparatus which comprises a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, the method characterized by comprising the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

Effects of the Invention

According to the present invention, when a communication connection with a device is disconnected during execution of a display operation based on data transmitted from the connected device, the display operation can be controlled to continue or end according to the device class.

Other features and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings. Note that the same reference numerals denote the same or similar components throughout the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodi-

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ments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. 1A is a view exemplifying a use mode of a display apparatus according to the present invention, that is, a schematic view exemplifying a use mode upon connecting a flash memory to a display apparatus to display an image:

FIG. 1B is a view exemplifying a use mode of the display apparatus according to the present invention, that is, a schematic view exemplifying a use mode upon connecting a digital camera to the display apparatus to display an image:

FIG. 2 is a block diagram illustrating the functional arrangement of the display apparatus:

FIG. 3 is a schematic view exemplifying an input selection menu window:

FIG. 4A is a flowchart showing the processing of the display apparatus:

FIG. 4B1 is a flowchart showing the processing of the display apparatus when "Mass Storage Class" is determined in step S804 in FIG. 4A:

FIG. 4B2 is a flowchart showing the sequel of FIG. 4B1:

FIG. 4C1 is a flowchart showing the processing of the display apparatus when "Imaging Class" is determined in step S804 in FIG. 4A:

FIG. 4C2 is a flowchart showing the sequel of FIG. 4C1:

FIG. 5A is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying an input waiting window:

FIG. 5B is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying a display of image data from the digital camera:

FIG. 5C is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying an incompatibility window:

FIG. 6A is a flowchart showing processing of the first modification (corresponding to FIG. 4C1) in the display apparatus:

FIG. 6B is a flowchart showing processing of the first modification (corresponding to FIG. 4C2) in the display apparatus:

FIG. 7 is a block diagram showing the peripheral arrangement of a CPU and USB connector 102 of the second modification in the display apparatus:

FIG. 8A is a flowchart showing processing of the second modification (continued from any of FIGS. 8B1 to 8C2) in the display apparatus:

FIG. 8B1 is a flowchart showing processing of the second modification (corresponding to FIG. 4B1) in the display apparatus:

FIG. 8B2 is a flowchart showing processing of the second modification (corresponding to FIG. 4B2) in the display apparatus:

FIG. 8C1 is a flowchart showing processing of the second modification (corresponding to FIG. 4C1) in the display apparatus:

FIG. 8C2 is a flowchart showing processing of the second modification (corresponding to FIG. 4C2) in the display apparatus:

FIG. 9A is a flowchart showing processing of the third modification (corresponding to FIG. 8A) in the display apparatus:

FIG. 9B is a flowchart showing processing of the third modification (corresponding to FIG. 4A) in the display apparatus:

FIG. 10A is a flowchart showing processing of the fourth modification (corresponding to FIG. 9A) in the display apparatus:

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FIG. 10B is a flowchart showing processing of the fourth modification (corresponding to FIG. 9B) in the display apparatus:

FIG. 11A is a schematic view showing an overview when a flash memory is connected to a conventional projector to display an image:

FIG. 11B is a schematic view showing details of a control panel:

FIG. 12 is a sequence chart showing the operation sequence when the flash memory is connected to the projector to display an image:

FIG. 13A is a schematic view exemplifying a connection request window projected by the projector onto a screen:

FIG. 13B is a schematic view exemplifying a file selection window projected by the projector onto the screen:

FIG. 13C is a schematic view exemplifying a display of image data which is stored in the flash memory, and is projected by the projector onto the screen:

FIG. 14A is a schematic view showing an overview when a digital camera is connected to a printer to output an image:

FIG. 14B is a block diagram showing the arrangement associated with a communication between the printer and digital camera:

FIG. 15 is a sequence chart showing the operation sequence when the digital camera is connected to the printer to output an image: and

FIG. 16 is a schematic view showing an overview when a digital camera is connected to a projector to display an image.

DESCRIPTION OF REFERENCE NUMERALS

- 1 . . . display apparatus
- 2 . . . screen
- 3 . . . flash memory
- 4 . . . digital camera
- 5 . . . USB cable

BEST MODE FOR CARRYING OUT THE INVENTION

An embodiment of the present invention will be described hereinafter with reference to the drawings, but the present invention is not limited to the embodiment to be described hereinafter. The embodiment of the present invention presents one aspect of the invention, and does not limit the scope of the invention.

A use mode of a display apparatus according to the present invention will be described first with reference to FIGS. 1A and 1B which exemplify the use modes of a display apparatus 1. As shown in FIG. 1A, as a use mode of the display apparatus 1, a flash memory 3 is connected to a USB connector 102 of the display apparatus 1, and an image stored in the flash memory 3 is projected and displayed as an image 21 on a screen 2. A control panel 101 includes various buttons used to accept operation instructions from the user. The user can browse image data stored in the flash memory 3 as the image 21 on the screen 2 by plugging the flash memory 3 into the USB connector 102 and operating the control panel 101.

Also, as shown in FIG. 1B, as another use mode, a digital camera 4 is connected to the USB connector 102 of the display apparatus 1 via a USB cable 5, and an image stored in the digital camera 4 is projected and displayed as an image 22 on the screen 2. The digital camera 4 has a liquid crystal panel screen 401, operation member 402, and operation button 403. The liquid crystal panel screen 401 displays a preview of an image and the like to be transferred to the display apparatus 1. The operation member 402 accepts a selection instruction of

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an image from the user. The operation button 403 is a button used to accept a transfer start instruction to the display apparatus 1 from the user. A projection display operation by the display apparatus 1 based on image data stored in the digital camera 4 is attained in such a manner that an image display instruction by an operation on the digital camera 4 side is output from the digital camera 4 to the display apparatus 1, and image data to be output is transmitted from the digital camera 4 to the display apparatus 1.

The user who uses the display apparatus 1 can appreciate an image captured by the digital camera 4 by projecting and displaying it onto the screen or can make a presentation for other users by projecting an image which is saved in the flash memory 3 and represents briefing paper.

Details of the display apparatus 1 will be described below with reference to FIG. 2. FIG. 2 is a block diagram illustrating the functional arrangement of the display apparatus 1. As shown in FIG. 2, a video signal is input to a video terminal 103 particularly via a video cable (not shown). The input video signal is converted into a digital video signal by an AD converter 104 (Analog-To-Digital) connected to the video terminal 103. A CPU 107 (to be described later) sets sampling parameters (a frequency, phase, etc.) upon AD conversion. Note that when an input video signal is a digital video signal, the AD converter 104 is not required, and the present invention is applicable when an appropriate receiver is used as needed.

The converted digital video signal is input to a video processor 105 connected to the AD converter 104. The video processor 105 applies video adjustment processing such as resolution conversion processing, contrast adjustment, and brightness, sharpness, and gamma corrections, and OSD image superimposing processing of a menu and the like. Note that "OSD" is an abbreviation for "On Screen Display".

The CPU 107 controls the operation of the video processor 105. Furthermore, the video processor 105 can receive arbitrary image data from the CPU 107. For example, when the CPU 107 transmits image data received by a USB host controller 110 to the video processor 105, the video processor 105 can output that video as a video signal.

The video signal output from the video processor 105 is input to a liquid crystal driver 106, and is converted into signals (e.g., RGB video signals) suited to drive liquid crystal panels 117, 118, and 119. The liquid crystal panels 117, 118, and 119, which respectively represent three primary colors, that is, Red, Green, and Blue, include liquid crystal pixels arranged in a matrix pattern, and form images based on input signals. The liquid crystal panels 117, 118, and 119 are arranged to transmit light emitted from a lamp (not shown) through them, and modulate light coming from the lamp by images formed based on the input signals.

A projection lens 120 projects and displays light modulated by the liquid crystal panels 117, 118, and 119 onto an external device (e.g., the screen 2). The control panel 101 has an up arrow button, left arrow button, down arrow button, right arrow button, enter button, input button, and power button as in the control panel 9101 that has been explained with reference to FIG. 11B. Pressing information of each button on the control panel 101 is sent to the CPU 107 as an operation instruction by the user. More specifically, that information is used to control a cursor movement, an enter operation, and the like of a menu on a display window.

The USB host controller 110 is a circuit which makes a USB communication with an external device using a VBUS line 111, D+ line 112, D- line 113, and GND line 114, which are specified in the USB standard. In the USB host controller 110, data to be transmitted/received is input/output by the

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CPU 107. The D+ line 112 and D- line 113 are USB communication lines used to make a differential communication, and are respectively pulled down by resistors 115 and 116. The VBUS line 111, D+ line 112, D- line 113, and GND line 114 are connectable to an external device via the USB connector 102 as a connection unit. The USB connector 102 serves as a USB interface which can connect a USB device as an external device. Therefore, the display apparatus 1 and USB device can communicate with each other via the USB connector 102.

The CPU 107 (Central Processing Unit) centrally controls the display apparatus 1. More specifically, the CPU 107 manages to start up and shut down the display apparatus 1, and controls the respective units such as the AD converter 104, video processor 105, USB host controller 110, and liquid crystal driver 106. A ROM 108 (Read Only Memory) stores program codes and various data required to operate the CPU 107. A CPU 107 (Random Access Memory) provides a work area required to let the RAM 109 operate.

The CPU 107 can select a video source to be displayed from the following two sources in addition to the startup processing of respective blocks after power-ON. The first video source is a video picture signal input from the video terminal 103. The second video source is image data transmitted from a device connected via the USB connector 102. The CPU 107 controls the video processor 105 to project an input selection menu window in response to a user's operation on the control panel 101 as a trigger. FIG. 3 is a schematic view exemplifying the input selection menu window. As shown in FIG. 3, the input selection menu window presents a selection menu of "external video" and "USB" as a video source to be displayed to the user.

After that, the CPU 107 receives a selection instruction input by a user's operation on the control panel 101, and executes a video source switching operation. In this video source switching operation, when "USB" is selected, and the projection display operation of image data from the flash memory 3 or digital camera 4 connected to the display apparatus 1 is to be executed, the CPU 107 sequentially executes the flowcharts including steps S801 to S832 exemplified in FIGS. 4A to 4C2. The processing of these flowcharts is executed until the power switch of the display apparatus 1 is turned off or until the input selection menu is displayed again, and "external video" is selected as a video source.

As shown in FIGS. 4A to 4C2, if the processing is started (S801), the CPU 107 controls the video processor 105 to project and display a USB device connection request window onto the screen 2 (S802). This connection request window is as has been described with reference to FIG. 13A, and prompts the user to connect a USB device. The connection request window is a kind of pattern image, and is displayed based on pattern image data stored in advance in the ROM 108.

The CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB device is communication-connected via the USB connector 102, and a USB communication is established (S803). If it is determined in step S803 that a USB communication is established, the process to be executed by the CPU 107 advances to the next step.

The CPU 107 sends an inquiry to the USB host controller 110 to determine a class of the communication-connected USB device (S804). This class is determined based on class information transmitted from the USB device when the USB host controller 110 establishes a USB communication with that USB device connected via the USB connector 102. More specifically, the class information of the USB device includes USB Mass Storage Class indicating the class of a device

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which is a simple storage and physically disconnects a communication connection. Also, the class information includes USB Imaging Class (often also called Imaging Device) indicating the class of a device which can execute communication control with the connected display apparatus 1 and can logically disconnect a communication connection depending on devices. Note that USB Mass Storage Class will be referred to as Mass Storage Class, and USB Imaging Class will be referred to as Imaging Class hereinafter. For example, the flash memory 3 transmits class information indicating Mass Storage Class to the display apparatus 1 at the time of connection, and the digital camera 4 transmits class information indicating Imaging Class to the display apparatus 1 at the time of connection. If the class information indicates Mass Storage Class in step S804, the process to be executed by the CPU 107 advances to step S805; if the class information indicates Imaging Class, the process advances to step S817; otherwise, the process advances to step S831.

FIG. 4A shows "Mass Storage Class" and "Imaging Class" as the device classes, but the present invention is not limited to these classes. For example, the display apparatus 1 may store a class for which an image display operation is to be continued and a class for which the operation is to be ended (or one of these classes) at the time of disconnection of a communication.

The CPU 107 executes a sequence of steps S805 to S816 when the communication-connected USB device is a USB mass storage such as the flash memory 3. In step S805, the CPU 107 reads out directory entry information stored in the USB device via the USB host controller 110.

In step S806, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S805 in this case). If it is determined in step S806 that the USB communication was disconnected, the process to be executed by the CPU 107 returns to step S802.

In step S807, the CPU 107 controls the video processor 105 to display a file selection window that enumerates image file names based on the readout directory entry information. This file selection window is as has been described with reference to FIG. 13B, and is a window that displays a file name list of image files stored in the flash memory 3 and a cursor used to select them. The display apparatus 1 prompts the user to select an image file to be displayed of those stored in the flash memory 3 using this file selection window.

The CPU 107 determines in step S808 whether or not a USB communication with the USB device was disconnected, as in step S806. The CPU 107 determines in step S809 whether or not the user has made an operation on the control panel 101. If it is determined in step S809 that the user has not made any operation, the process to be executed by the CPU 107 returns to step S808.

In step S810, the CPU 107 updates the file selection window based on the user's operation on the control panel 101. More specifically, when the user presses the up or down arrow button on the control panel 101, the CPU 107 reconfigures and displays a window on which the cursor to be rendered to select a file of interest has been moved.

The CPU 107 determines in step S811 based on a user's operation on the control panel 101 whether or not the user has made an operation to select an image file to be displayed. More specifically, when the user presses the enter button on the control panel 101, the CPU 107 determines that an image file in a cursor line is determined as that to be displayed. If no image file selection operation is made, the process to be executed by the CPU 107 returns to step S808.

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In step S812, the CPU 107 reads out a file image of the image file selected in step S811 from the USB device via the USB host controller 110. The CPU 107 determines in step S813 whether or not a USB communication with the USB device was disconnected, as in step S806.

In step S814, the CPU 107 controls the video processor 105 to project and display an image based on the readout file image on the screen 2, after the image is scaled to match the resolution of the liquid crystal panels 117, 118, and 119. The image which is projected and displayed on the screen 2 is the same as that which has been described with reference to FIG. 13C, and is based on image data stored in advance in the flash memory 3.

The CPU 107 determines in step S815 whether or not a USB communication with the USB device was disconnected, as in step S806. The CPU 107 determines in step S816 based on a user's operation on the control panel 101 whether or not the user gives the instruction to end the image display operation. More specifically, the CPU 107 makes this determination by acquiring pressing information of the enter button on the control panel 101. If the user does not give the instruction to end the image display operation, the process to be executed by the CPU 107 returns to step S815. If the user gives the instruction to end the image display operation, the process to be executed by the CPU 107 returns to step S807, and the file selection window is displayed again to prompt the user to select another image file.

On the other hand, the CPU 107 executes a sequence of steps S817 to S830 when the connected USB device corresponds to, for example, Imaging Class such as the digital camera 4 compatible to the PictBridge. Note that the PictBridge-compatible digital camera 4 will be exemplified below, and a case will be described wherein the scheme of the PictBridge is diverted, and the projection display operation of the display apparatus 1 is made using a print instruction (image output) from the digital camera 4. In step S817, the CPU 107 executes PictBridge connection processing with respect to the USB device via the USB host controller 110. Note that this processing corresponds to step S502, which has been explained with reference to FIG. 15.

In step S818, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S817 in this case). If it is determined in step S818 that the USB communication was disconnected, the process to be executed by the CPU 107 advances to step S830.

The CPU 107 determines in step S819 whether or not the PictBridge connection processing in step S817 has succeeded, and a PictBridge connection is established. If a PictBridge connection is not established because, for example, the USB device to be connected is incompatible to the PictBridge, the process to be executed by the CPU 107 advances to step S831.

In step S820, the CPU 107 controls the video processor 105 to project and display an input waiting window. This input waiting window is a window used to prompt the user to print an image file (or to transfer an image to a projector) by the PictBridge function from the digital camera side, as shown in FIG. 5A. Note that this step S820 corresponds to an idle state in which the control waits for a "print" instruction in step S503 described with reference to FIG. 15.

The CPU 107 determines in step S821 whether or not a USB communication with the USB device was disconnected, as in step S818. The CPU 107 determines in step S822 whether or not a print job start communication is made from the USB device via the USB host controller 110. This communication corresponds to step S504 which has been

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explained with reference to FIG. 15. If it is determined in step S822 that no start instruction is issued, the process to be executed by the CPU 107 returns to step S821.

The CPU 107 determines in step S823 whether or not a USB communication with the USB device was disconnected, as in step S818. In step S824, the CPU 107 acquires information of an image file to be output included in the print job from the USB device via the USB host controller 110. This step S824 corresponds to step S505 which has been described with reference to FIG. 15.

The CPU 107 determines in step S825 whether or not a USB communication with the USB device was disconnected, as in step S818. In step S826, the CPU 107 acquires an image of the image file included in the print job from the USB device via the USB host controller 110. This step S826 corresponds to step S506 which has been described with reference to FIG. 15.

The CPU 107 determines in step S827 whether or not a USB communication with the USB device was disconnected, as in step S818. In step S828, the CPU 107 controls the video processor 105 to project and display the acquired image on the screen 2, after the image is scaled to match the resolution of the liquid crystal panels 117, 118, and 119. The image, which is projected and displayed on the screen 2, is an image based on image data captured by the digital camera, and is an image of a person or the like, as shown in, for example, FIG. 5B.

In step S829, the CPU 107 notifies the USB device, via the USB host controller 110, that a communication state based on the PictBridge connection transits to an idle state. This notification in step S829 corresponds to step S508 which has been described with reference to FIG. 15.

If it is determined in step S818, S821, S823, S825, or S827 that the USB communication was disconnected, the process of the CPU 107 advances to step S830. The CPU 107 determines in step S830 whether or not the projection display operation of an image based on the image acquired from the USB device is in progress (i.e., whether or not the process has passed step S828). If the projection display operation of the image is in progress, the process of the CPU 107 returns to step S803; otherwise, the process of the CPU 107 returns to step S802.

On the other hand, if an incompatible device class is determined in step S804, or if it is determined in step S819 that a PictBridge connection is not established, the process of the CPU 107 advances to step S831. In step S831, the CPU 107 controls to project and display an incompatibility window. This incompatibility window is a window used to notify the user that the connected USB device is incompatible to the display apparatus 1, as shown in FIG. 5C.

In step S832, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected. This determination in step S832 continues until the USB communication is disconnected, and if the USB communication is disconnected, the process of the CPU 107 returns to step S802.

As described above, when a USB communication is disconnected while the display apparatus 1 is connected to a USB device such as a flash memory device, and executes the projection display operation of image data stored in that device, the display apparatus 1 overwrites an image whose projection display operation is in progress by the connection request window (S802). When the class of the connected device corresponds to, for example, the flash memory device, the USB connection is disconnected mainly by removal of the device by the user. Furthermore, the user removes the device with the intention to end the projection display operation.

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Hence, when the USB connection is disconnected, it is preferable for the display apparatus 1 to overwrite an image, whose projection display operation is in progress, by the connection request window without continuing the projection display operation.

On the other hand, when a USB connection is disconnected while the display apparatus 1 is connected to a USB device such as a digital camera, and executes the projection display operation of image data stored in that device, the display apparatus 1 continues to display the image, whose projection display operation is in progress, without being overwritten by the connection request window (transition from step S830 to step S803). When the class of the connected device corresponds to, for example, the digital camera, the USB communication may be disconnected either by removal of the device by the user or by control on the USB device side. Therefore, since the USB connection is disconnected by not only removal of the device by the user who intended to end the projection display operation, it is preferable for the display apparatus 1 to continue to display an image, whose projection display operation is in progress, when the USB connection is disconnected.

That is, when a communication is disconnected while the display apparatus 1 executes the projection display operation based on image data from the connected device, the display apparatus 1 controls whether or not to continue the display operation of the image whose projection display operation is in progress according to the class of the connected device. Therefore, the display apparatus 1 can eliminate the opportunity of a display state which is likely to occur depending on the class of the connected device and is not intended by the user. For example, the display apparatus 1 can eliminate occurrence of situations that the image display operation is unwantedly ended in a case in which the user intends to browse images and that the image display operation is unwantedly continued in a case in which the user intends to end image browsing. Note that, in this embodiment, the image of the connection request window is used as an overwrite image. Alternatively, for example, a solid black or blue-black pattern image may be used.

[First Modification]

As the first modification of the aforementioned embodiment, a case will be described wherein the processes of FIGS. 4C1 and 4C2 of those to be executed by the CPU 107 of the display apparatus 1 exemplified in FIGS. 4A to 4C2 are modified like the flowcharts shown in FIGS. 6A and 6B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided.

As shown in FIGS. 6A and 6B, in the first modification, steps S818, S823, S825, and S827 in the sequence of the CPU 107 exemplified in FIGS. 4C1 and 4C2 are respectively replaced by steps S1318, S1323, S1325, and S1327.

In step S1318, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S817 in this case). If it is determined in step S1318 that the USB communication was disconnected, the process to be executed by the CPU 107 returns to step S802. Note that the processing contents in steps S1323, S1325, and S1327 are the same as in step S1318.

In step S821, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S820 in this case). If it is determined in step S821 that the USB communication was disconnected, the process to be executed by the CPU 107 advances to step S830. That is, when the USB communication is disconnected at the

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display timing of the input waiting window, and in an idle state of the communication, since the process of the CPU 107 temporarily advances to step S830, an image can be prevented from being immediately overwritten by the connection request window.

As described above, in the first modification, the following processes of the display apparatus 1 executed when a communication is disconnected while the display apparatus 1 is connected to the PictBridge-compatible device and executes the projection display operation of an image stored in that device are different from the aforementioned embodiment. When the PictBridge connection is not in an idle state, that is, a communication is underway at the time of the aforementioned communication disconnection, the display apparatus 1 overwrites an image whose projection display operation is in progress by the connection request window. When the PictBridge connection is in an idle state, that is, a communication is not underway, an image whose projection display operation is in progress is continuously displayed.

When the PictBridge connection is in a non-idle state, that is, a communication is underway, a USB communication is more likely to be disconnected at that time not by control on the USB device side but by, for example, removal of the USB device by the user. Therefore, when a communication is disconnected during the USB communication, it is preferable for the display apparatus 1 to overwrite an image, whose projection display operation is in progress, by the connection request window without continuously displaying the image. When a communication is disconnected while the USB communication is in an idle state, such disconnection may be caused either by removal of the USB device by the user or by control on the USB device side. Therefore, since a USB communication in an idle state is disconnected by not only removal of the device by the user who intends to end the projection display operation, it is preferable for the display apparatus 1 to continue to display an image whose projection display operation is in progress.

[Second Modification]

The second modification of the aforementioned embodiment will be described below. In the second modification, the peripheral arrangement of the CPU 107 and USB connector 102 of the display apparatus 1 exemplified in FIG. 2 is modified, as shown in FIG. 7. Also, in the second modification, the processes to be executed by the CPU 107 of the display apparatus 1 exemplified in FIGS. 4B1 to 4C2 are modified, as shown in the flowcharts shown in FIGS. 8A to 8C2. Note that the same reference numerals denote the same components, and a repetitive description thereof will be avoided.

As shown in FIG. 7, the display apparatus 1 includes an insertion detector 121 which detects insertion of a USB plug in the USB connector 102. In the insertion detector 121, a conductive terminal 1212 having a projection 1211, which is arranged at a position where the projection 1211 physically interferes with a USB plug, and a grounded conductive terminal 1213 are arranged in the USB connector 102 to be brought into contact with each other when a USB plug is not inserted. The conductive terminal 1212 is pulled up by a resistor 122, and is connected to an input port of the CPU 107.

Therefore, in the insertion detector 121, when a USB plug is inserted into the USB connector 102, the USB plug pushes up the conductive terminal 1212, and the conductive terminals 1212 and 1213 are open. Hence, the CPU 107 can recognize insertion/removal of the USB plug to/from the USB connector 102.

In the second modification, steps S806, S808, S813, S815, S818, S821, S823, S825, and S827 shown in FIGS. 4B1 to

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4C2 are changed, as shown in FIGS. 8B1 to 8C2, and FIG. 8A having steps S1530 and S1533 is added.

In step S1506, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S805 in this case). If it is determined in step S1506 that the USB communication was disconnected, the process to be executed by the CPU 107 advances to step S1530. Note that the processing contents in steps S1508, S1513, S1515, S1518, S1521, S1523, S1525, and S1527 are the same as in step S1506.

The CPU 107 determines in step S1530 whether or not the projection display operation of an image based on image data acquired from the USB device is in progress (that is, whether or not the process has passed step S814 or S828). If the projection display operation of the image is in progress, the process of the CPU 107 advances to step S1533; otherwise, the process of the CPU 107 returns to step S802.

The CPU 107 determines in step S1533 using the insertion detector 121 whether or not a USB plug is physically removed from the USB connector 102. If it is determined in step S1533 that the USB plug is physically removed, the process of the CPU 107 returns to step S802. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU 107 returns to step S803.

As described above, in the second modification, when the USB plug is physically removed and a USB communication is disconnected during the projection display operation of image data stored in the connected USB device, the display apparatus 1 overwrites the image whose projection display operation is in progress by the connection request window. Note that when a USB communication is disconnected not by physical removal of the USB plug, the display apparatus 1 does not overwrite the image whose projection display operation is in progress by the connection request window. Thus, the display apparatus 1 can eliminate occurrence of situations that the image display operation is unwantably ended in a case in which the user intends to browse images and that the image display operation is unwantably continued in a case in which the user intends to end image browsing.

[Third Modification]

The third modification, which further modifies the processing of the aforementioned second modification, will be described below with reference to the flowcharts shown in FIGS. 9A and 9B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided. As shown in FIGS. 9A and 9B, in the third modification, step S1533 is replaced by step S1633 in the sequence of the CPU 107 exemplified in FIG. 8A (FIG. 9A), and steps S1634 to S1636 are added in the sequence of the CPU 107 exemplified in FIG. 4A (FIG. 9B).

The CPU 107 determines in step S1633 using the insertion detector 121 whether or not a USB plug is physically removed from the USB connector 102. If it is determined in step S1633 that the USB plug is physically removed, the process of the CPU 107 returns to step S802. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU 107 advances to step S1634.

In step S1634, the CPU 107 sets and starts a timer which performs a count-down operation for a predetermined period (second period) specified in advance in the ROM or the like. If the CPU 107 determines in step S1635 that the timer started in step S1634 reaches a time-out, or the user issues an instruction on the control panel 101, the process returns to step S802.

In step S1636, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not the USB device is connected, and a USB communication is estab-

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lished. If it is determined in step S1636 that the USB communication is established, the process of the CPU 107 advances to step S804. On the other hand, if it is determined that the USB communication is not established, the process of the CPU 107 returns to step S1635. Therefore, in steps S1634 to S1636, the processing waits before the user issues an instruction or the second period set by the timer elapses until the USB communication is established.

As described above, in the third modification, when the USB plug is physically removed and the USB communication is disconnected while the projection display operation of image data stored in the connected USB device is in progress, the display apparatus 1 overwrites the image whose projection display operation is in progress by the connection request window. On the other hand, when it is determined that the USB plug is not physically removed, the image whose projection display operation is in progress is not overwritten by the connection request window until the second period elapses or the user issues an instruction. Hence, the display apparatus 1 can eliminate occurrence of situations that the image display operation is unwantedly ended in a case in which the user intends to browse images and that the image display operation is unwantedly continued in a case in which the user intends to end image browsing.

[Fourth Modification]

The fourth modification that further modifies the aforementioned third modification will be described below with reference to the flowcharts shown in FIGS. 10A and 10B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided. As shown in FIGS. 10A and 10B, in the fourth modification, step S1633 is replaced by step S1733 in the sequence of the CPU 107 exemplified in FIG. 9A (FIG. 10A), and step S1737 is added to the sequence of the CPU 107 exemplified in FIG. 9B (FIG. 10B).

The CPU 107 determines in step S1733 using the insertion detector 121 whether or not a USB plug is physically removed from the USB connector 102. If it is determined in step S1733 that the USB plug is physically removed, the process of the CPU 107 advances to step S1737. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU 107 advances to step S1634.

In step S1737, the CPU 107 sets and starts a timer which performs a count-down operation for a predetermined period (first period) which is set in advance in the ROM or the like, and is shorter than the second period set in step S1634.

As described above, in the fourth modification, when the USB plug is physically removed, and a USB communication is disconnected while the projection display operation of image data stored in the connected USB device is in progress, the display apparatus 1 overwrites the image whose projection display operation is in progress by the connection request window. The connection request window is overwritten when the first period set to be shorter than the second period elapses or when the user issues an instruction. On the other hand, when it is determined that the USB plug is not physically removed, the image whose projection display operation is in progress is not overwritten by the connection request window until the second period set to be longer than the first period elapses or the user issues an instruction.

Note that the description of the aforementioned embodiment is merely an example, and the present invention is not limited to this. The arrangement and operation in the aforementioned embodiment can be modified as needed. For example, the projector has been exemplified as the display apparatus in this embodiment, but a PDP, LCD, SED, CRT monitor, and the like may be used. Note that "PDP" is an

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abbreviation for "Plasma Display Panel". Also, "LCD" is an abbreviation for "Liquid Crystal Display". "SED" is an abbreviation for "Surface-Conduction Electron-emitter Display". Furthermore, "CRT" is an abbreviation for "Cathode Ray Tube".

This embodiment has exemplified the arrangement using USB, but the present invention is not particularly limited to this. For example, an SDIO (Secure Digital Input/Output) interface and other interfaces may be used. Furthermore, as an external storage device using a USB mass storage, an SD (Secure Digital) card memory, CF card, and the like may be used.

In the second, third, and fourth modifications, the insertion detector 121, which is a mechanism for detecting a physical contact of the connector, is used as means for detecting a physical connection of the USB plug, but the detection mechanism is not particularly limited. For example, as another means for detecting a physical connection of the USB plug, a current amount that flows through the VBUS line may be measured, and if the measured current amount exceeds a predetermined value, it may be determined that the USB plug is physically connected.

Other Embodiments

The aforementioned embodiments can be implemented in a software manner by a computer (or a CPU, MPU, etc.) of a system or apparatus. Therefore, a computer program itself supplied to the computer to implement the aforementioned embodiments using the computer implements the present invention. That is, the computer program itself required to implement the functions of the aforementioned embodiments is one invention of the present invention.

Note that the form of the computer program required to implement the aforementioned embodiments is not particularly limited as long as that program is computer-readable. For example, the program may adopt the forms of an object code, a program to be executed by an interpreter, script data to be supplied to an OS, and the like, but the present invention is not limited to them. The computer program required to implement the aforementioned embodiments is supplied to the computer via a storage medium or wired/wireless communications. As the storage medium for supplying the program, for example, magnetic storage media such as a flexible disk, hard disk, and magnetic tape, optical/magneto-optical storage media such as an MO, CD, and DVD, a nonvolatile semiconductor memory, and so forth may be used.

As a computer program supply method using the wired/wireless communications, a method using a server on a computer network is available. In this case, a server stores a data file (program file) that can be a computer program which forms the present invention. The program file may be either an executable format file or source codes. Then, the program file is supplied by downloading to a client computer that has accessed the server. In this case, the program file may be segmented into a plurality of segment files, which may be allocated on different servers. That is, the server which provides the program file required to implement the aforementioned embodiments to the client computer is also one invention of the present invention.

Also, a storage medium, which stores the encrypted program required to implement the aforementioned embodiments, may be delivered, and key information required to decrypt the encrypted program may be supplied to the user who meets a predetermined condition, so as to allow that user to install the program on a computer of the user. The key information can be supplied to the user by making him or her

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download it from a homepage via, for example, the Internet. The computer program required to implement the aforementioned embodiments may use the functions of an OS which already runs on the computer. Furthermore, some functions of the computer program required to implement the aforementioned embodiments may be configured by firmware which runs on an expansion board or the like attached to the computer, or may be executed by a CPU equipped on the expansion board or the like.

The present invention is not limited to the above embodiments and various changes and modifications can be made within the spirit and scope of the present invention. Therefore, to apprise the public of the scope of the present invention, the following claims are appended.

This application claims the benefit of Japanese Patent Application No. 2008-141678, filed May 29, 2008, which is hereby incorporated by reference herein in its entirety.

The invention claimed is:

1. A display apparatus characterized by comprising:
a display unit;

a connection unit configured to connect an external device to be able to communicate with the external device; and
a control unit configured to control said display unit to make a display based on data received from the external device with which a communication connection is established via said connection unit.

characterized in that said control unit acquires class information indicating a class of the external device from the external device via said connection unit, controls said display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls said display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

2. The display apparatus according to claim 1, characterized in that the predetermined class is a class of a device which logically disconnects a communication connection.

3. The display apparatus according to claim 1, characterized in that if the class information indicates a USB mass storage class, said control unit controls to end the display.

4. The display apparatus according to claim 1, characterized in that if the class information is class information indicating a USB imaging class, said control unit controls to continue the display.

5. The display apparatus according to claim 4, characterized in that even if the class information is the class information indicating the USB imaging class, when the communication connection with the external device is disconnected during a communication with the external device, said control unit controls to end the display.

6. The display apparatus according to claim 1, characterized by further comprising:

a detection unit configured to detect whether or not the external device is physically connected to said connection unit.

characterized in that if said detection unit detects that a physical connection with the external device is disconnected at the time of disconnection of the communication connection with the external device, said control unit controls to end the display irrespective of the class information.

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7. The display apparatus according to claim 6, characterized in that said control unit controls to end the display after a predetermined first period elapses.

8. The display apparatus according to claim 7, characterized in that if said detection unit detects that a physical connection with the external device is not disconnected at the time of disconnection of the communication connection with the external device, said control unit controls to end the display irrespective of the class information after a predetermined second period elapses.

9. The display apparatus according to claim 8, characterized in that the first period is shorter than the second period.

10. The display apparatus according to claim 1, characterized in that when the communication connection with the external device is disconnected, and said control unit controls to end the display based on the class information, said control unit controls said display unit to display a pre-set image.

11. A control method of a display apparatus which comprises:

a display unit;

a connection unit configured to connect an external device to be able to communicate with the external device; and
a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit.

the method characterized by comprising:

the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

12. A program for making a computer execute each step of the control method of a display apparatus according to claim 11.

13. A display apparatus characterized by comprising:

a display unit;

a connection unit configured to connect an external device to be able to communicate with the external device; and
a control unit configured to control said display unit to make a display based on data received from the external device with which a communication connection is established via said connection unit.

characterized in that said control unit acquires class information indicating a class of the external device from the external device via said connection unit, controls said display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls said display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

14. A control method of a display apparatus which comprises:

a display unit;

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a connection unit configured to connect an external device
to be able to communicate with the external device; and
a control unit configured to control the display unit to make
a display based on data received from the external device
with which a communication connection is established 5
via the connection unit.
the method characterized by comprising:
the control step of acquiring class information indicating a
class of the external device from the external device via
the connection unit, controlling the display unit to end 10
the display based on the data received from the external

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device at the time of disconnection of the communica-
tion connection with the external device if the class of
the external device indicated by the class information is
a predetermined class, and controlling the display unit to
continue the display based on the data received from the
external device at the time of disconnection of the com-
munication connection with the external device if the
class of the external device indicated by the class infor-
mation is not the predetermined class.

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(54) **DISPLAY APPARATUS, CONTROL METHOD THEREOF, AND PROGRAM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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See application file for complete search history.

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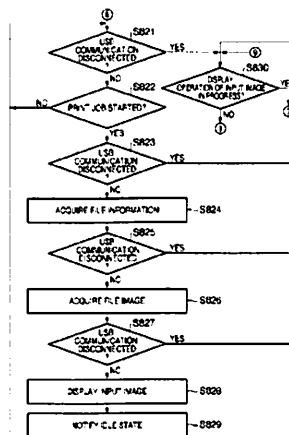
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(57) ABSTRACT

A display apparatus includes a communication unit configured to communicate with an external device, a display unit configured to display an image received from the external device, and a storing unit configured to store information for controlling whether or not to continue the display of the image being displayed by the display unit when the communication is disconnected. In addition, a determination unit determines whether or not to continue the display of the image received from the external device by comparing the type of the external device involving the communication by the communication unit with the information stored in the storing unit, and a control unit controls whether or not to continue the display of the image being displayed by the display unit when the communication is disconnected, in accordance with the determination.

11 Claims, 28 Drawing Sheets



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FIG. 1A

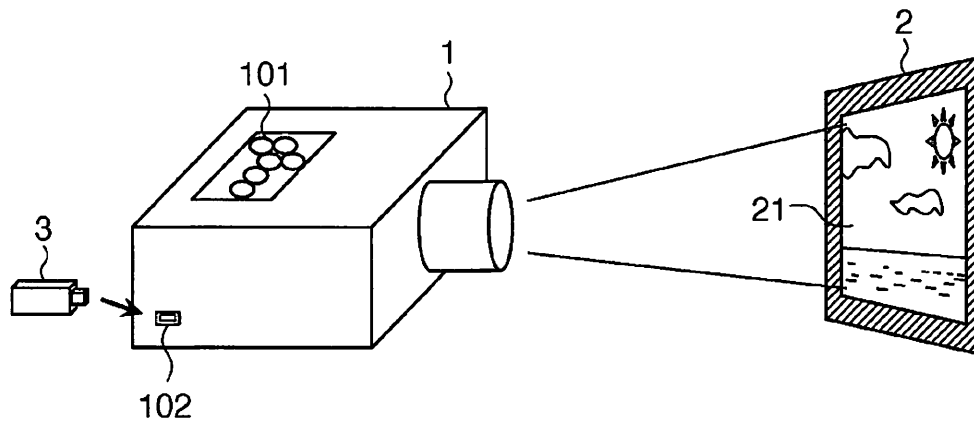


FIG. 1B

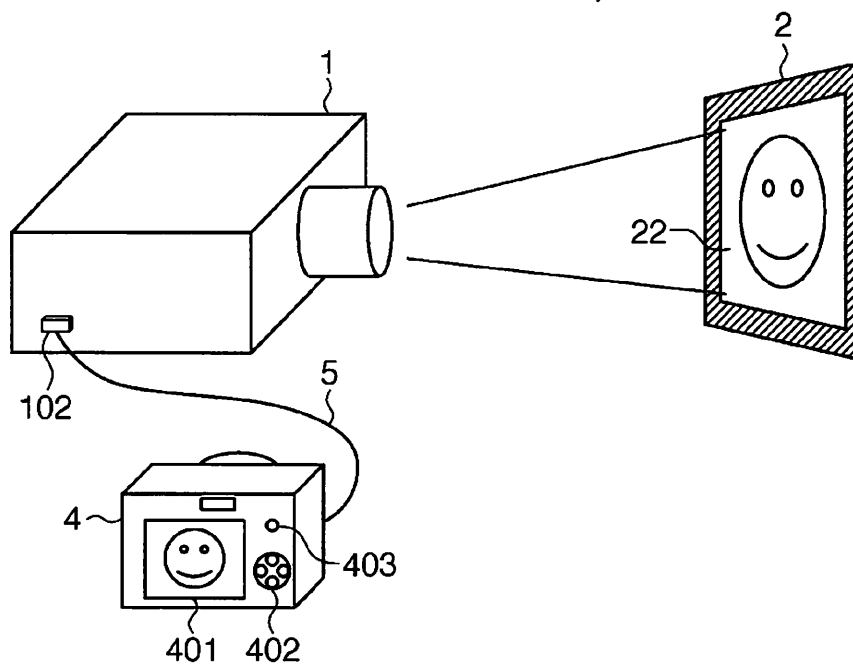
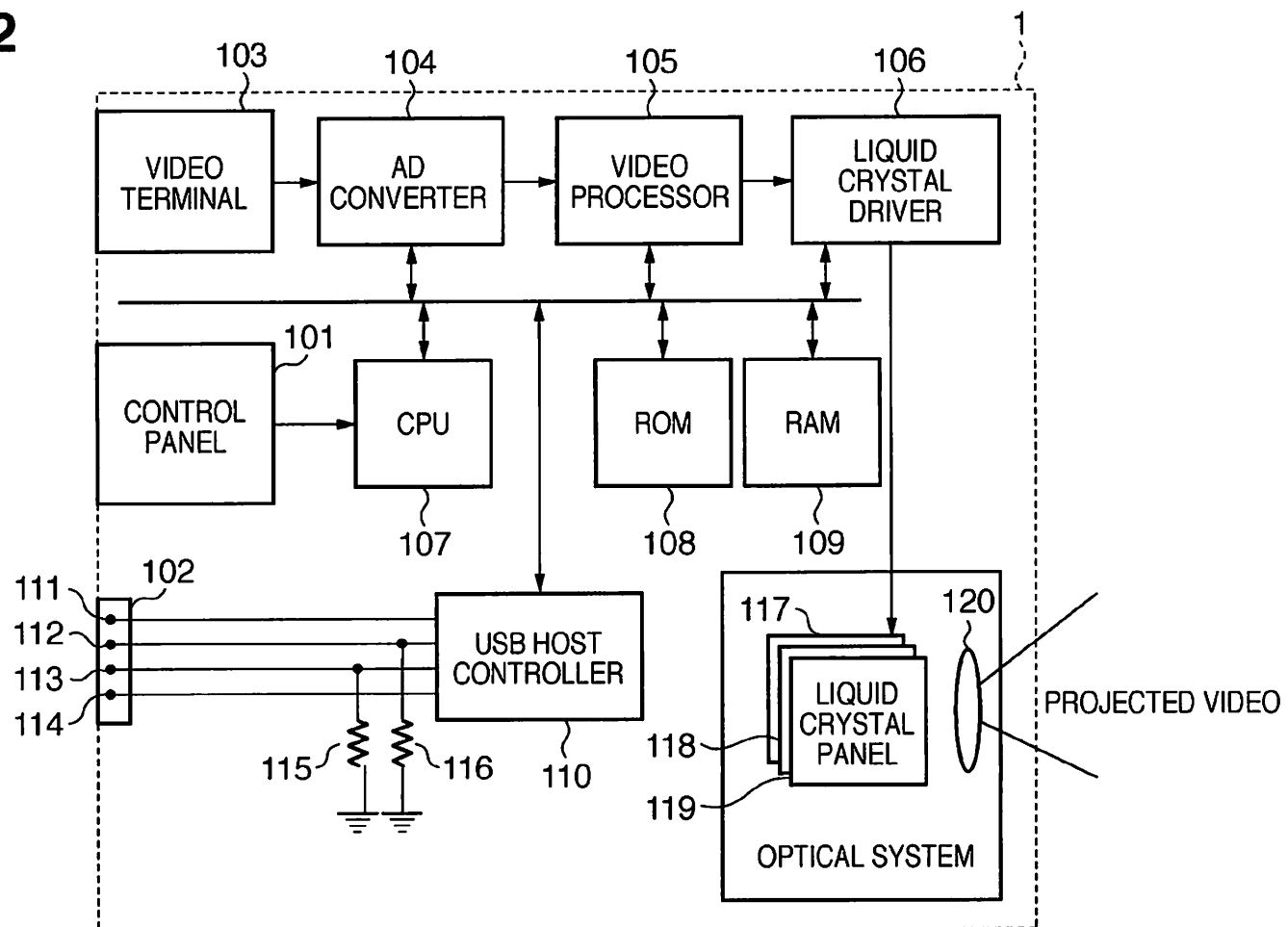


FIG. 2

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FIG. 3

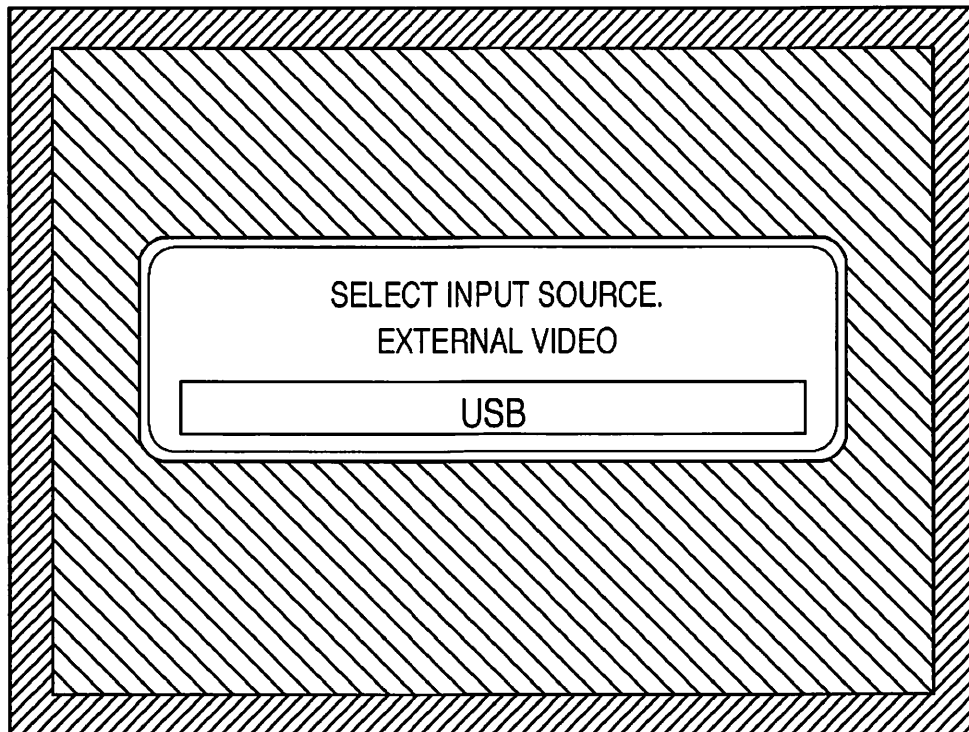
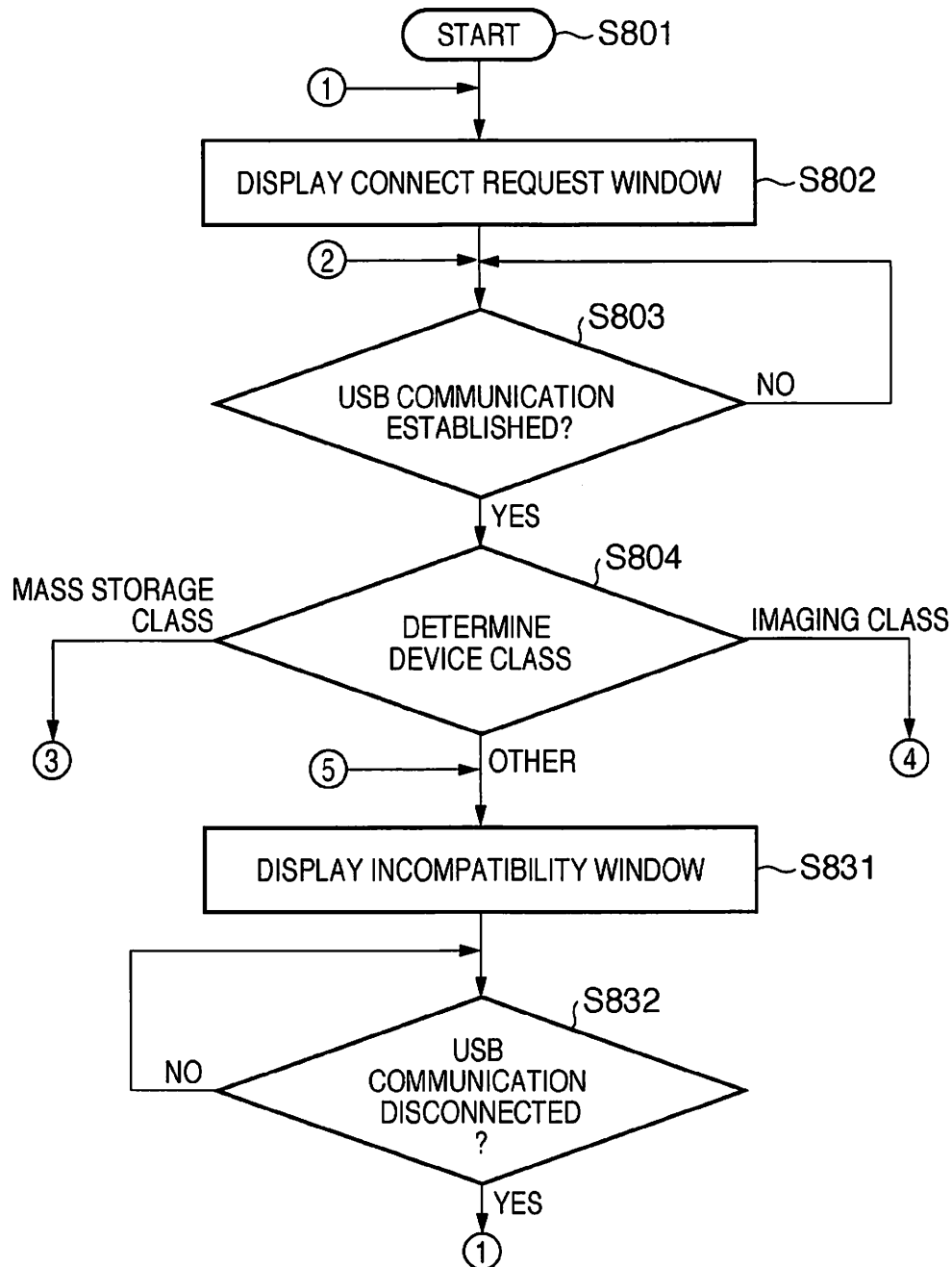


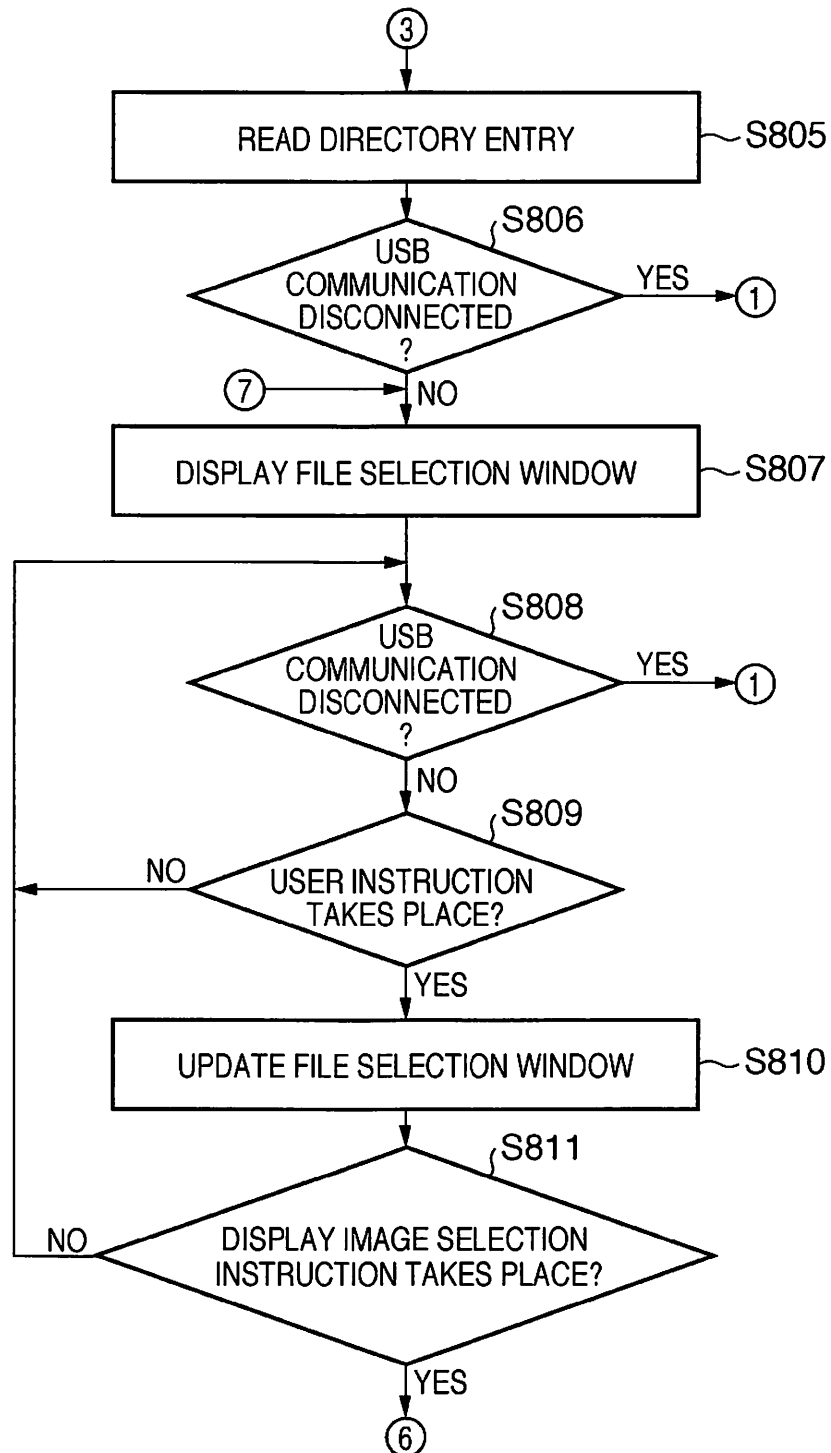
FIG. 4A

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FIG. 4B-1

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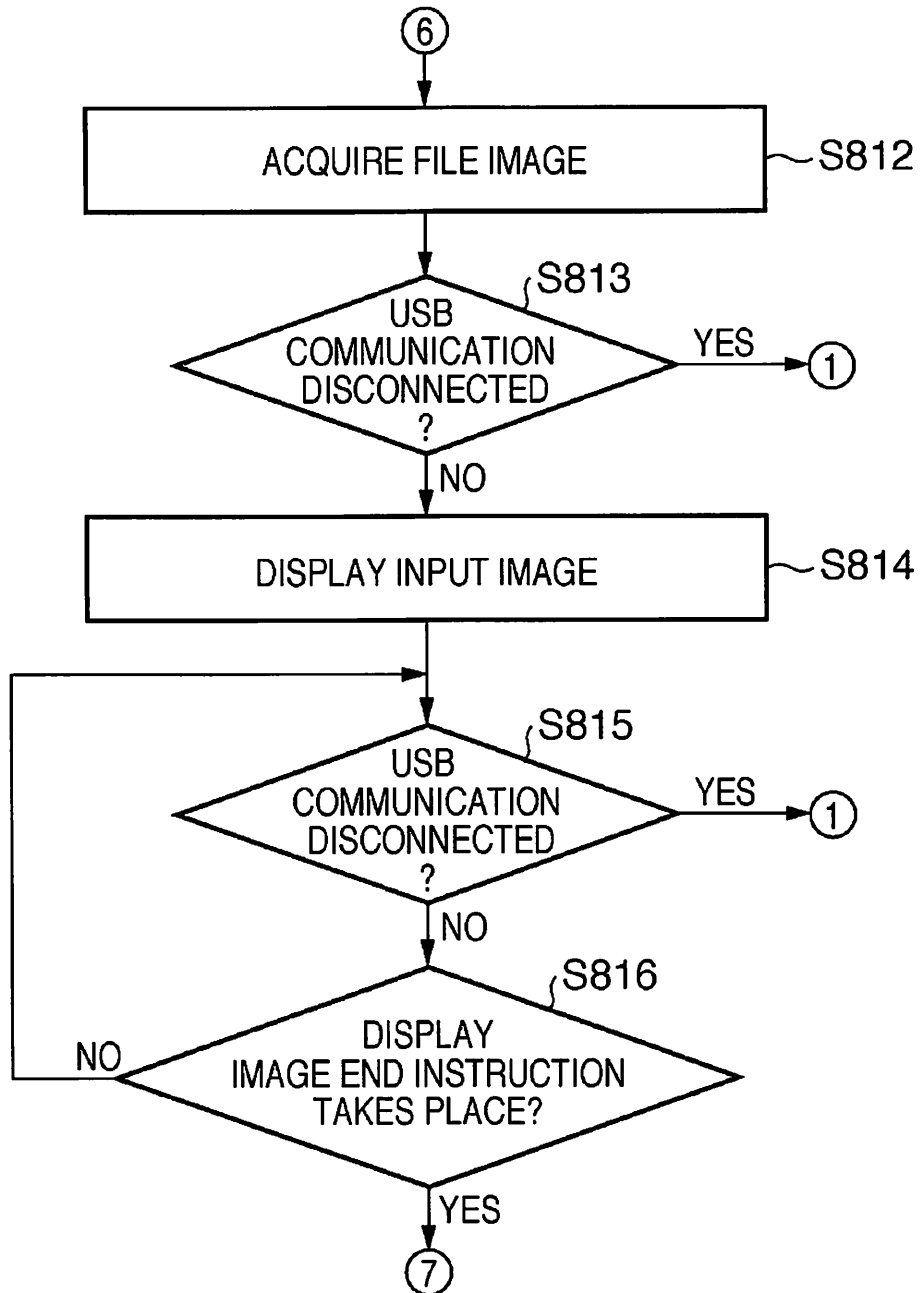
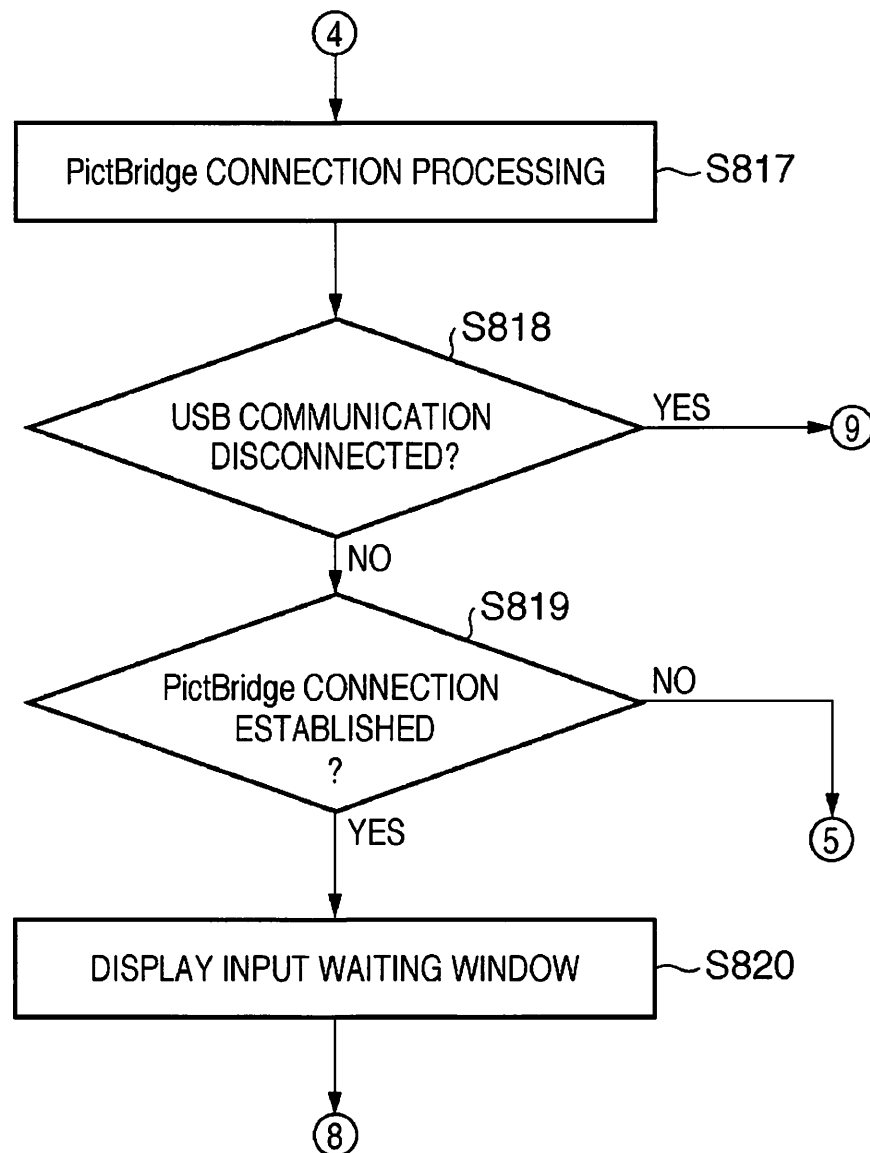
FIG. 4B-2

FIG. 4C-1

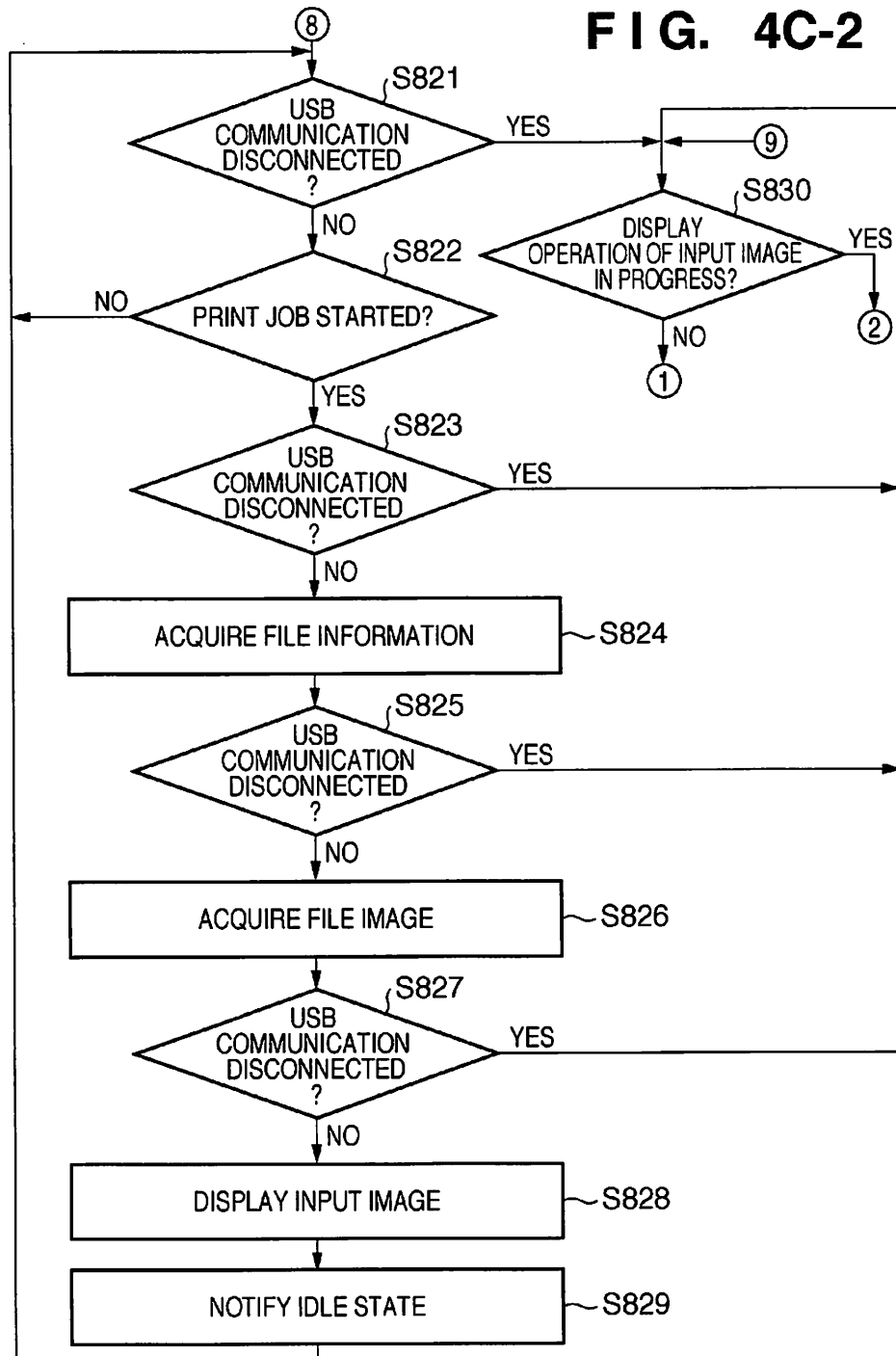
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FIG. 4C-2



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FIG. 5A

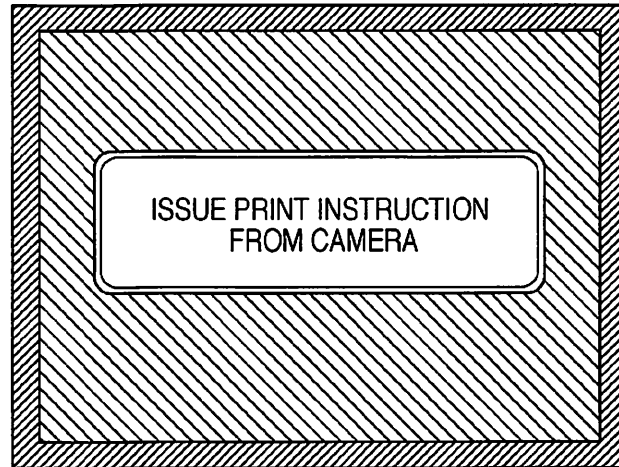


FIG. 5B

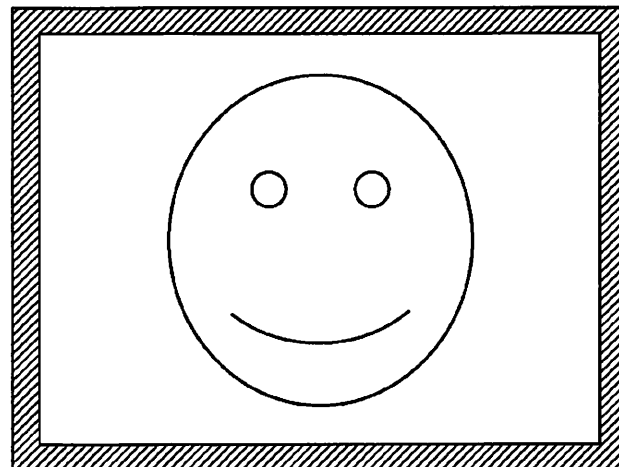
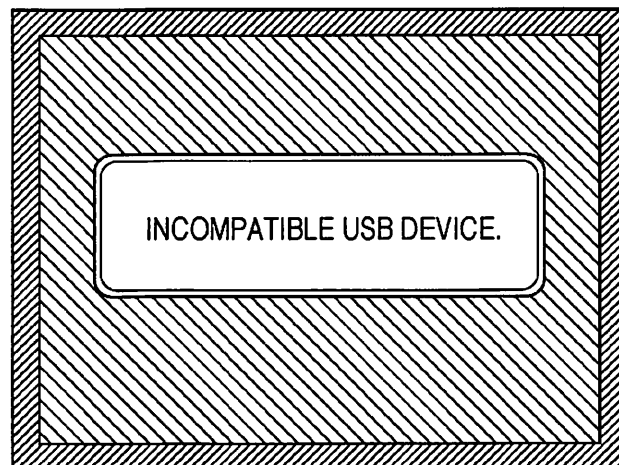


FIG. 5C

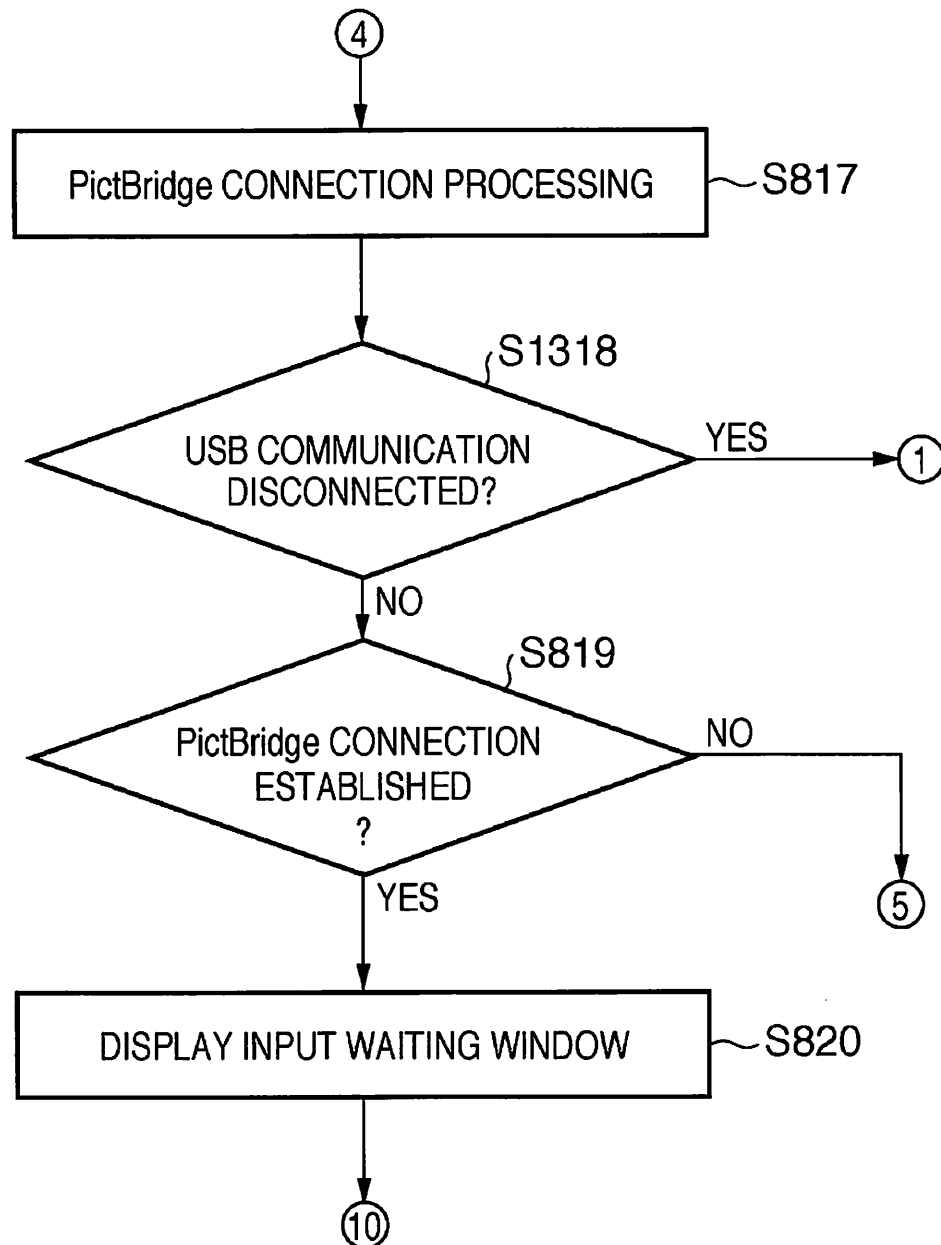


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FIG. 6A

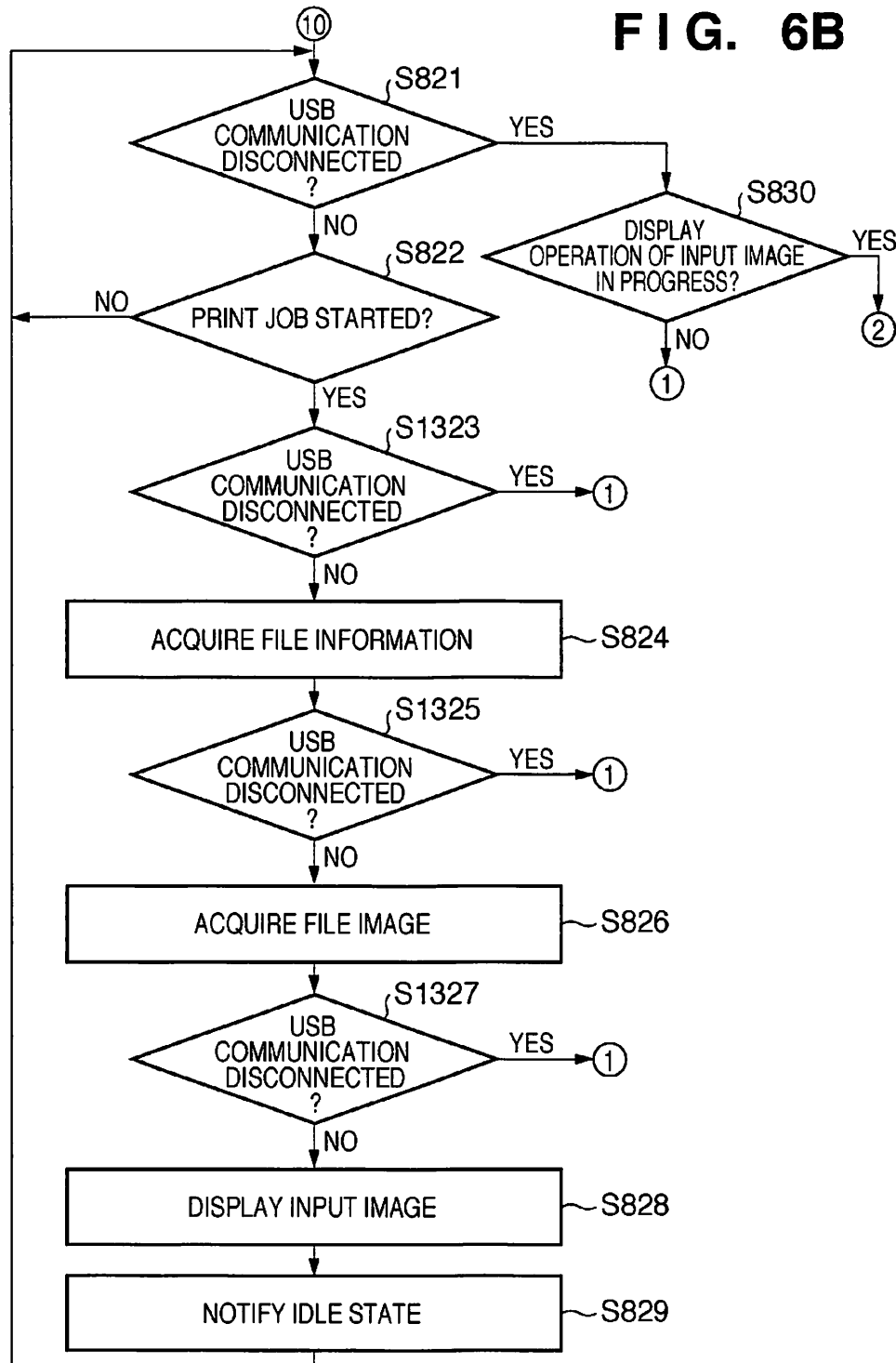
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FIG. 6B



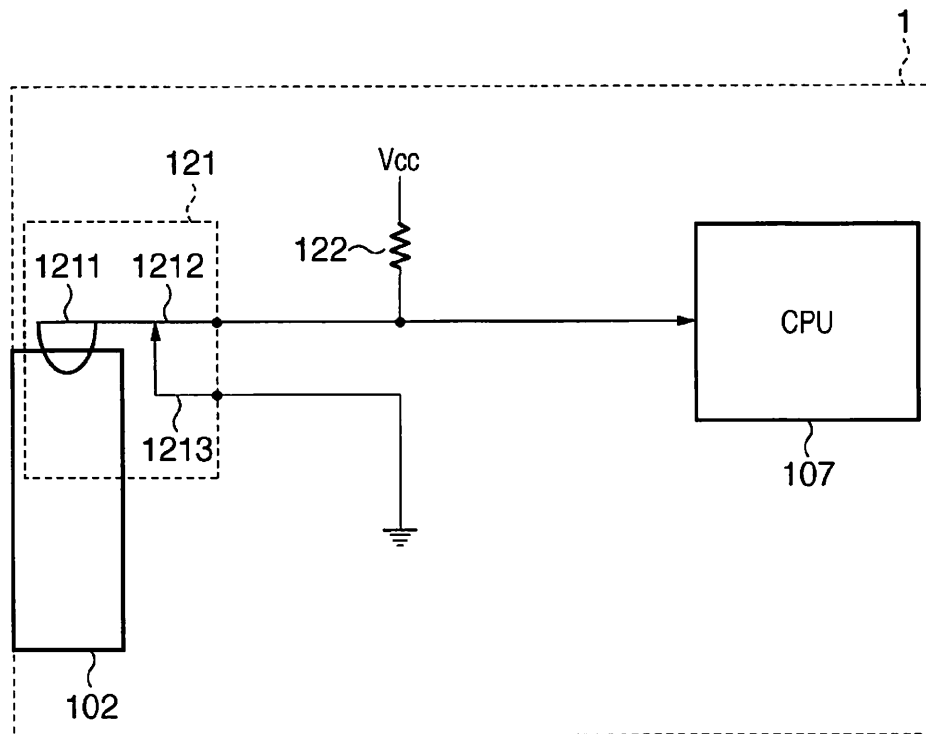
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FIG. 7

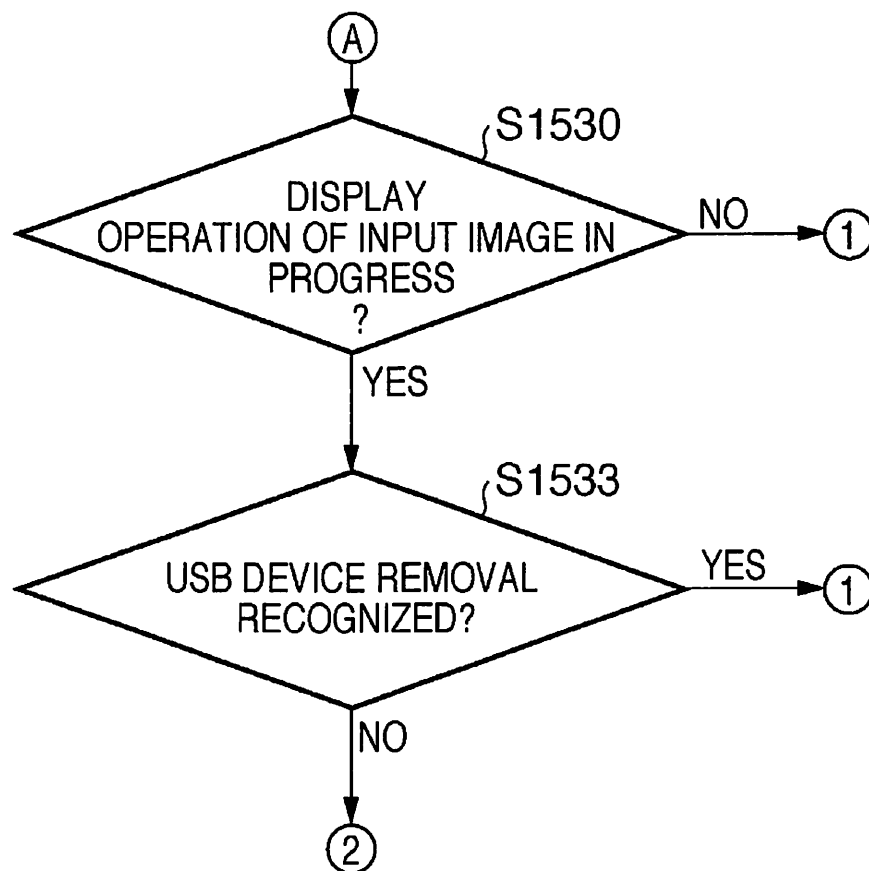


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FIG. 8A

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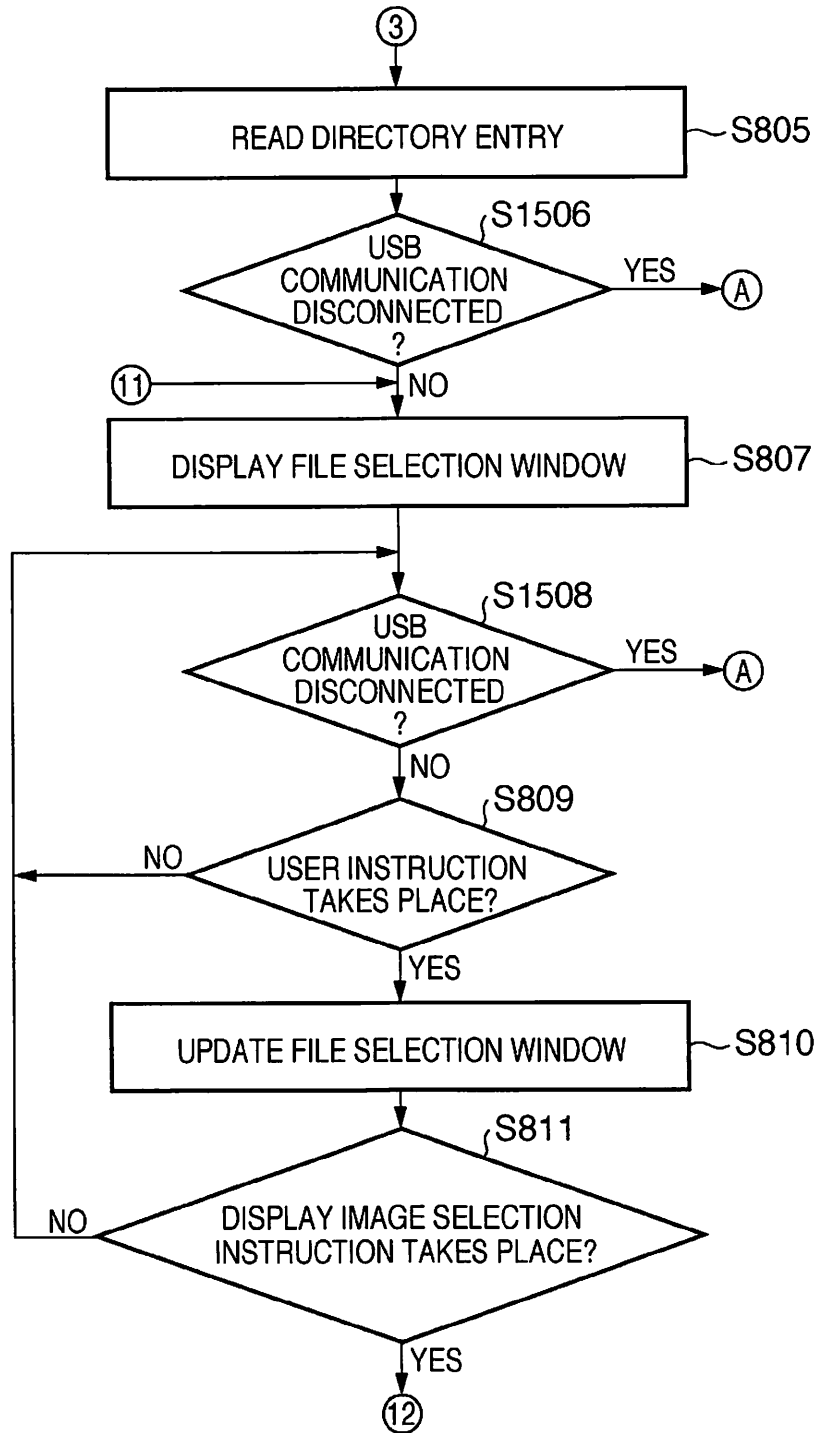
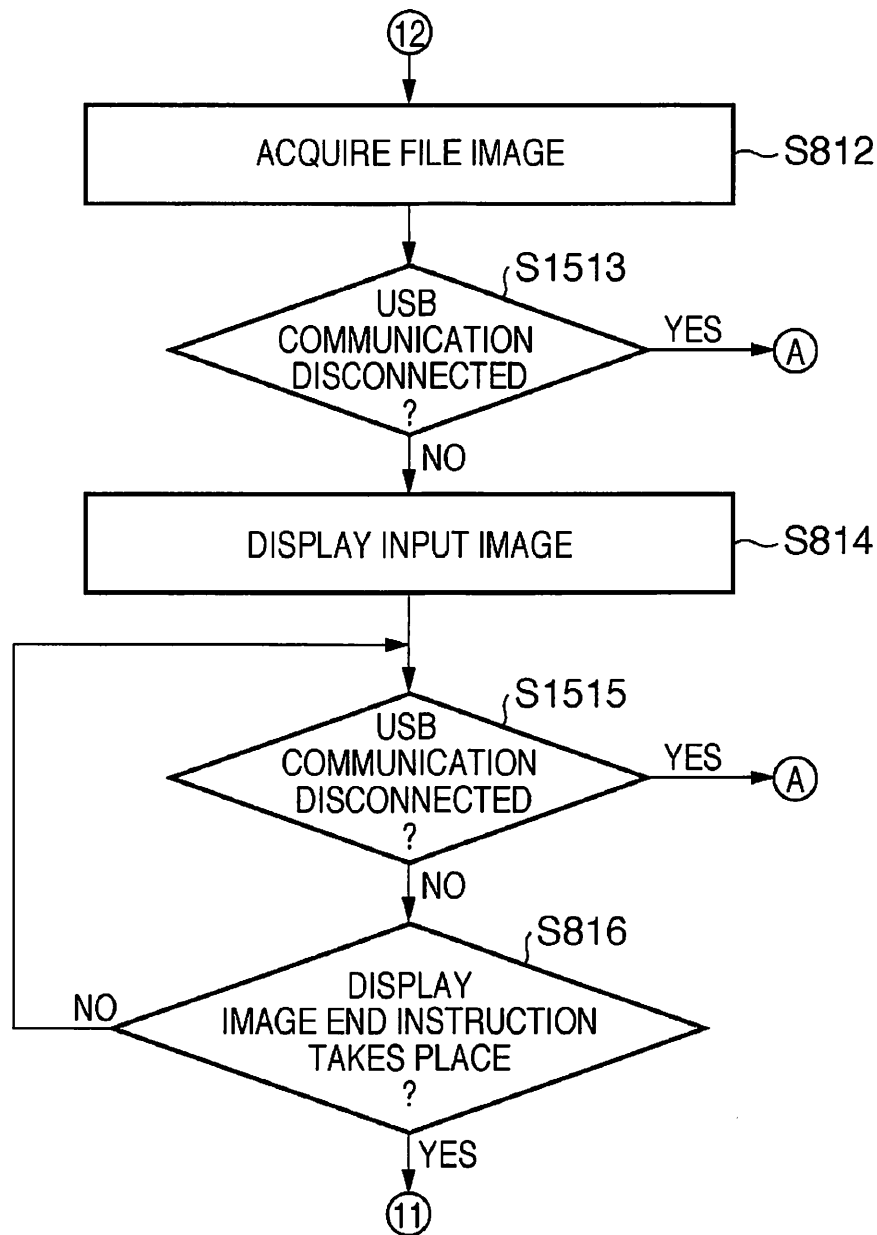
FIG. 8B-1

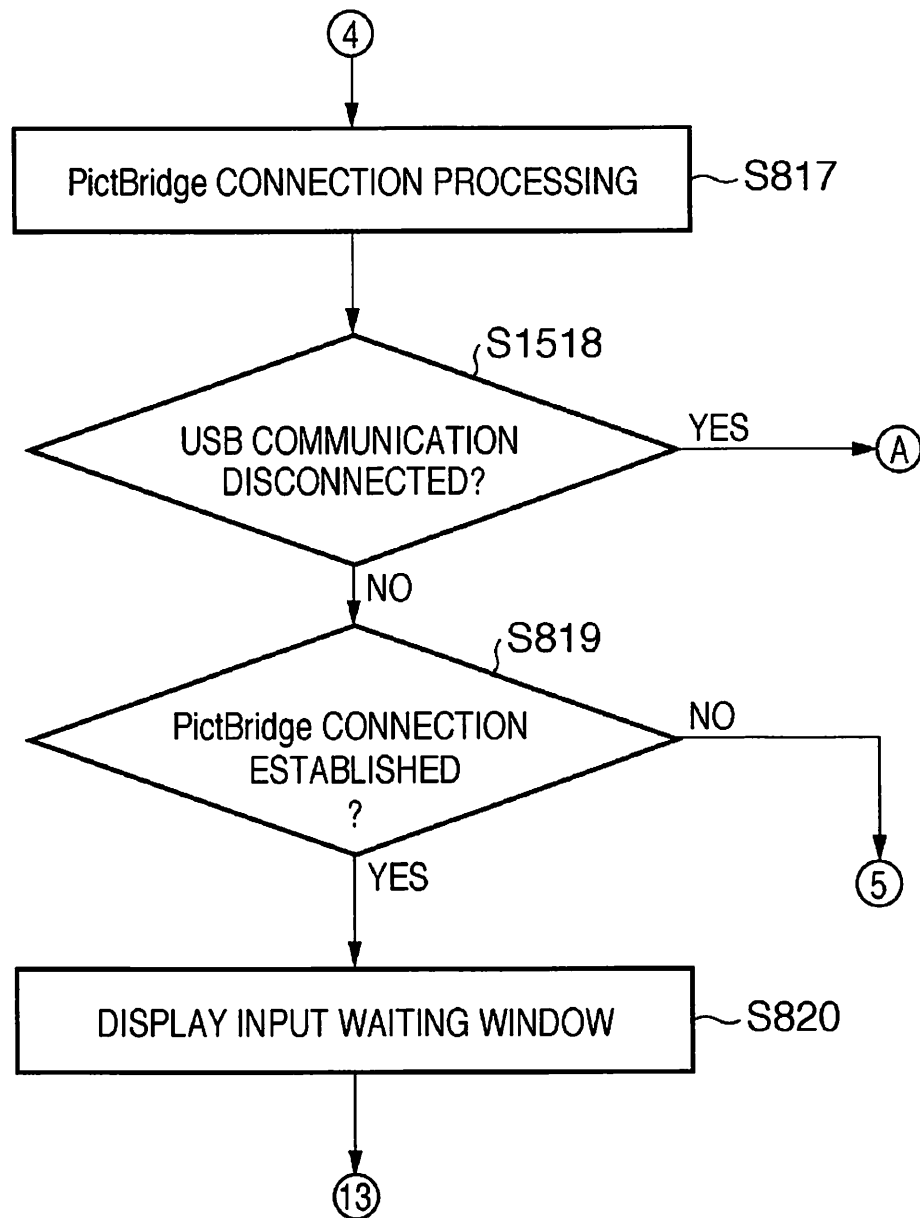
FIG. 8B-2

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FIG. 8C-1

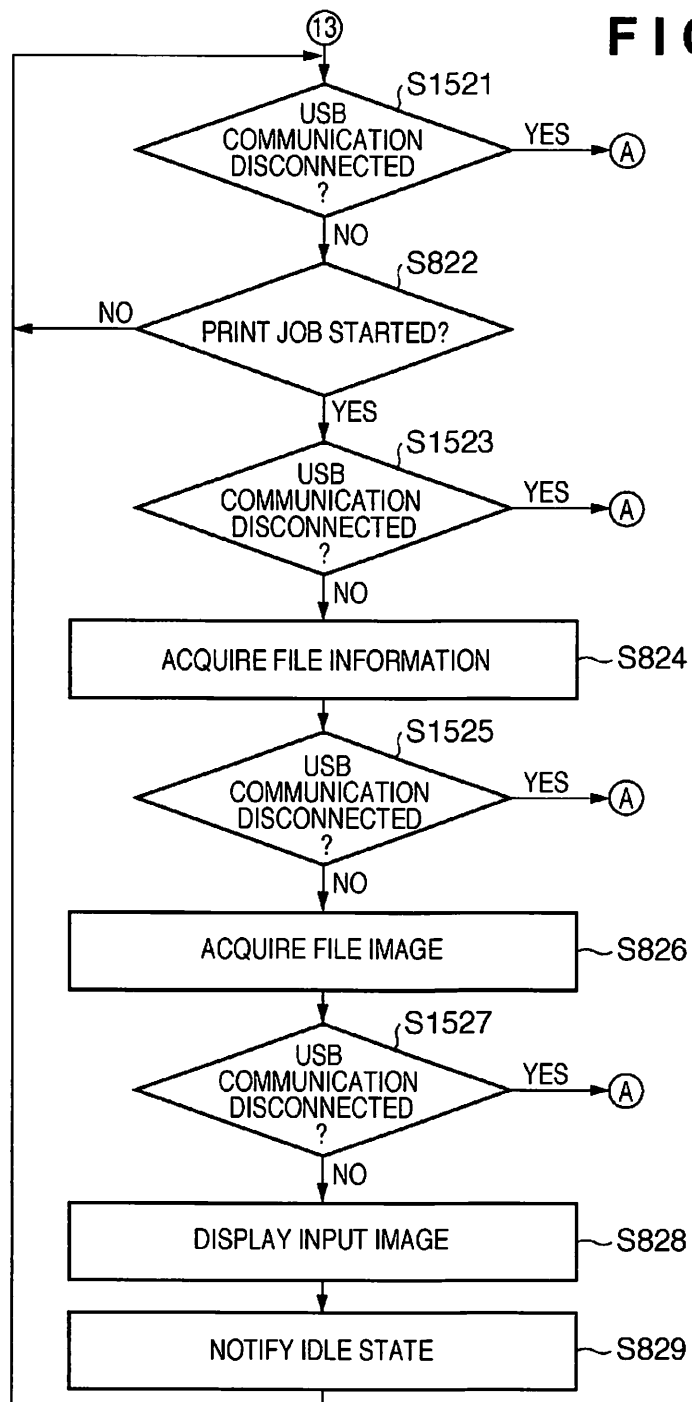
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FIG. 8C-2

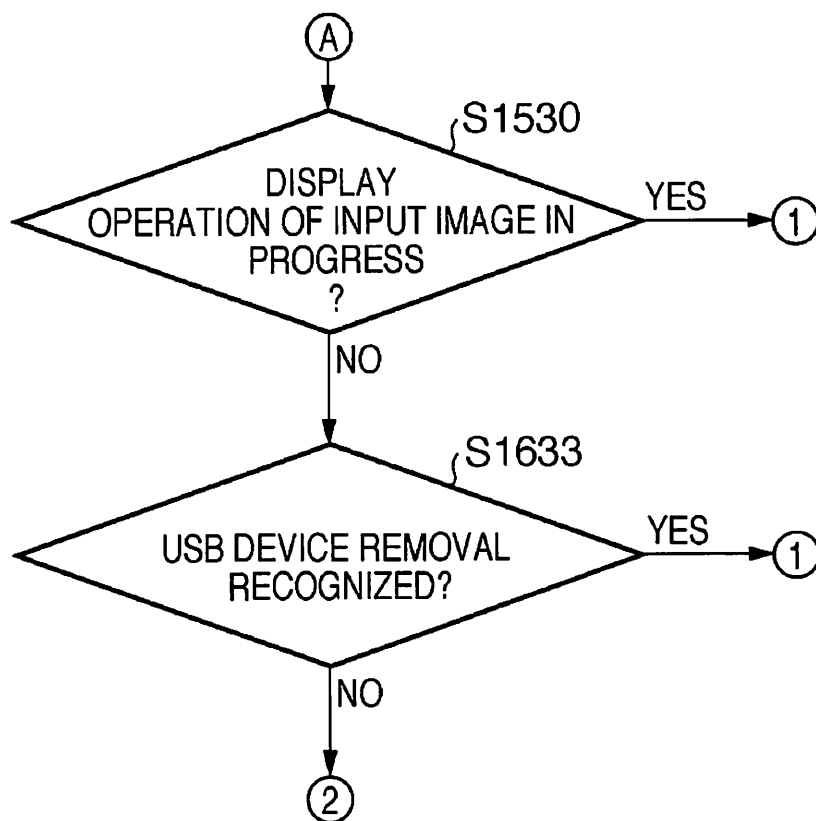


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FIG. 9A

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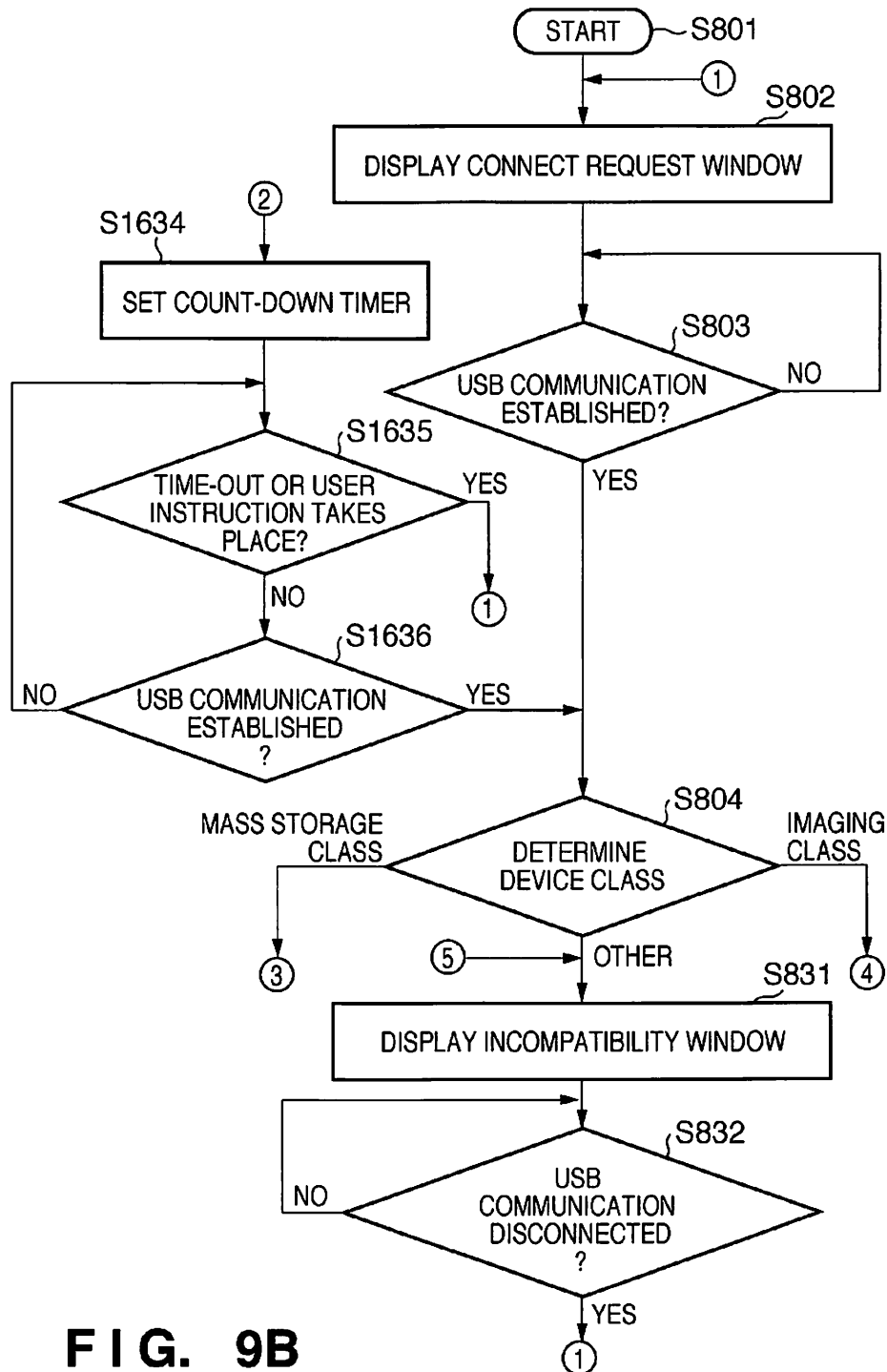


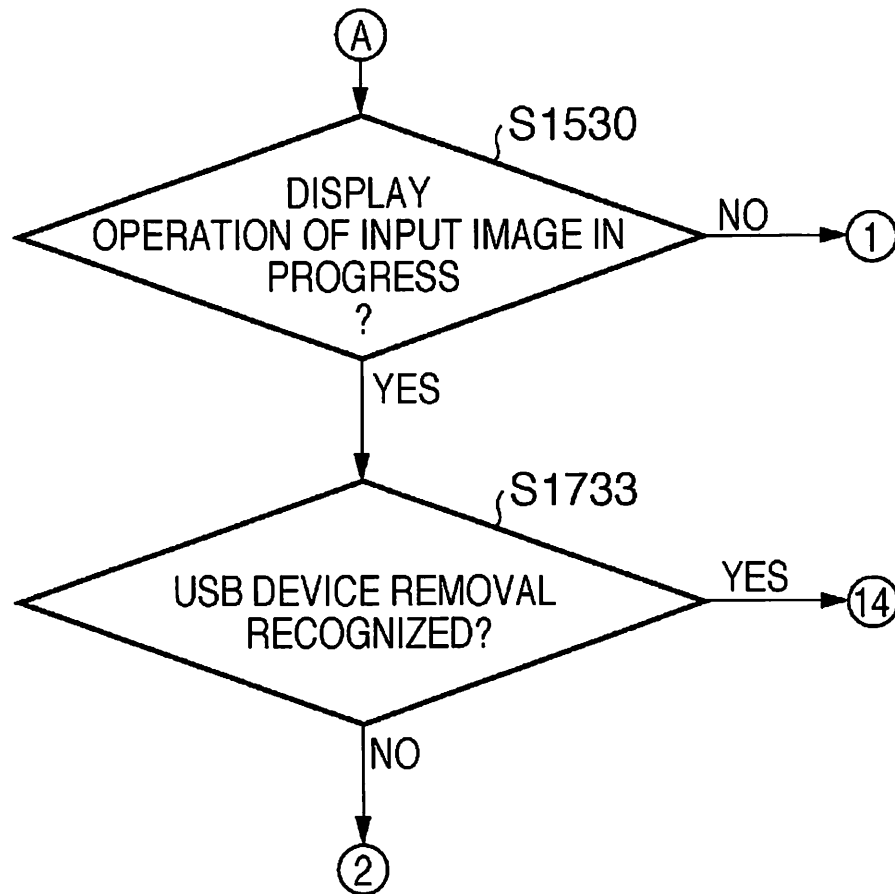
FIG. 9B

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FIG. 10A

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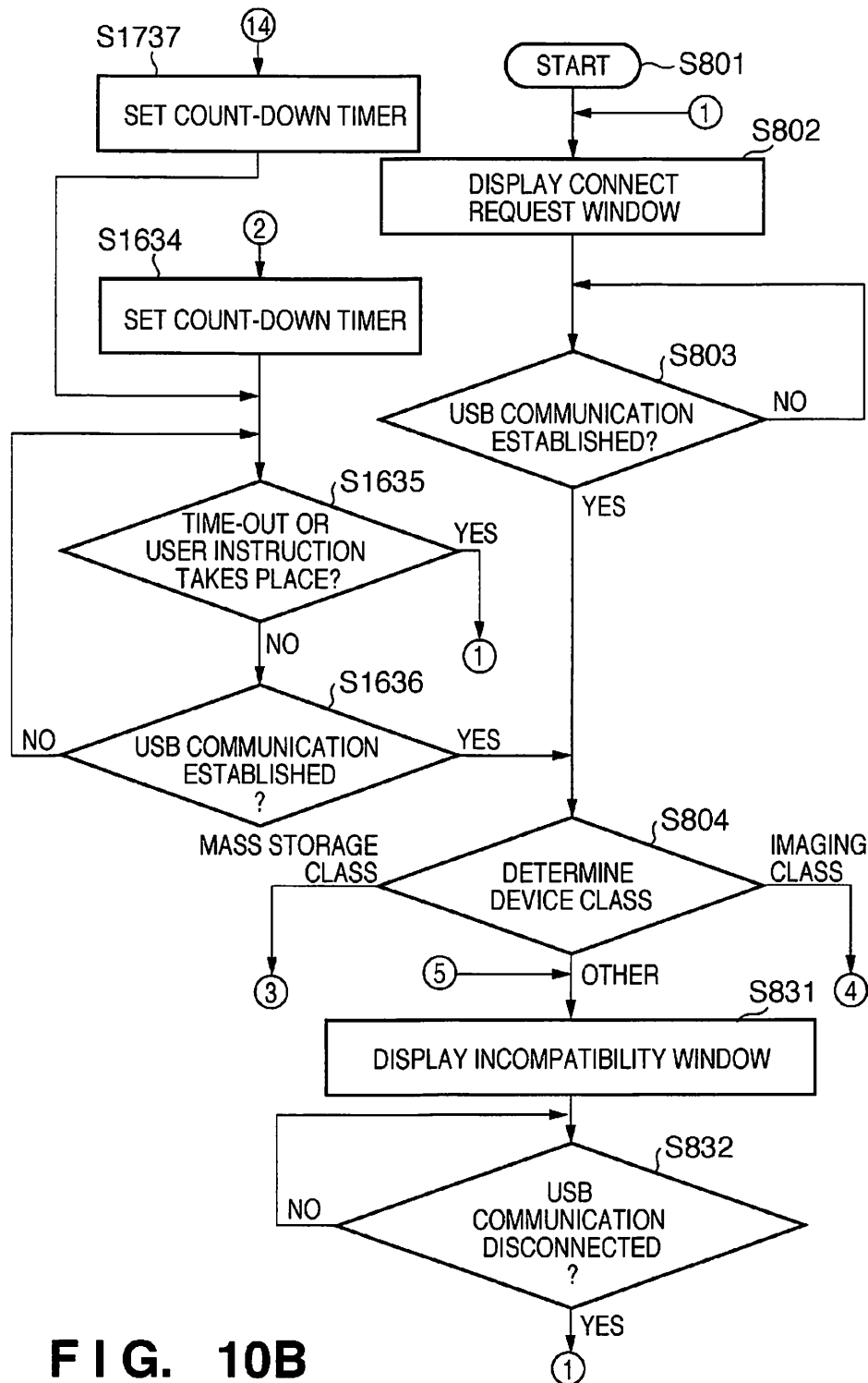


FIG. 10B

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FIG. 11A

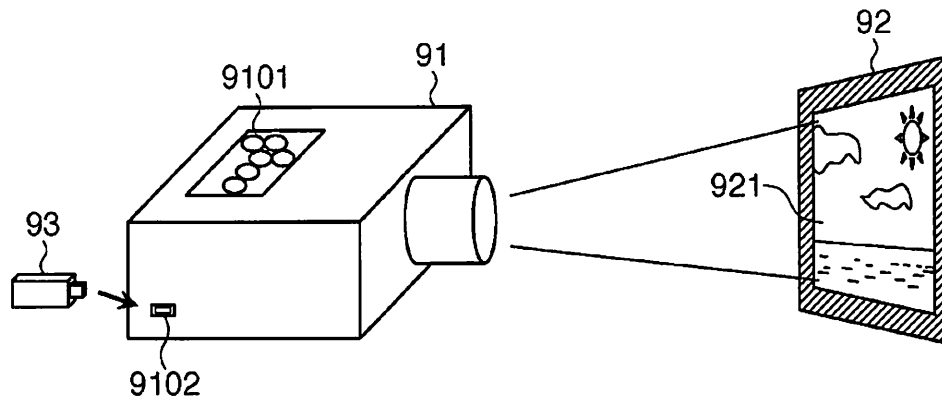
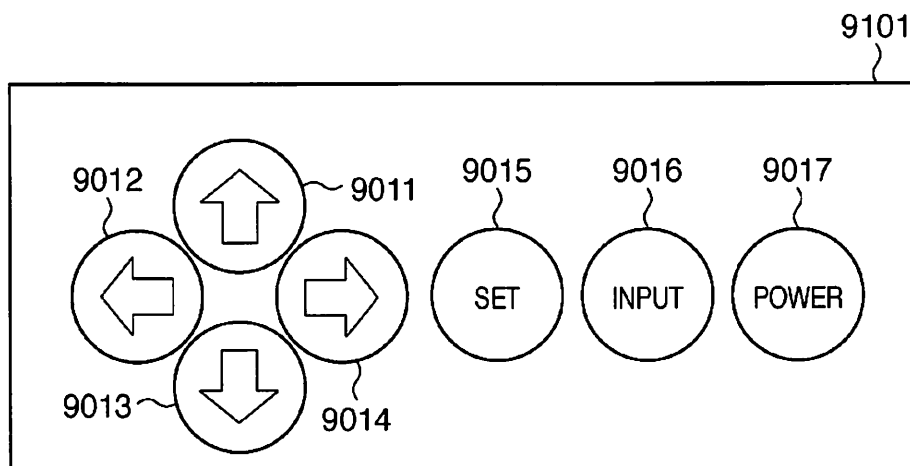


FIG. 11B

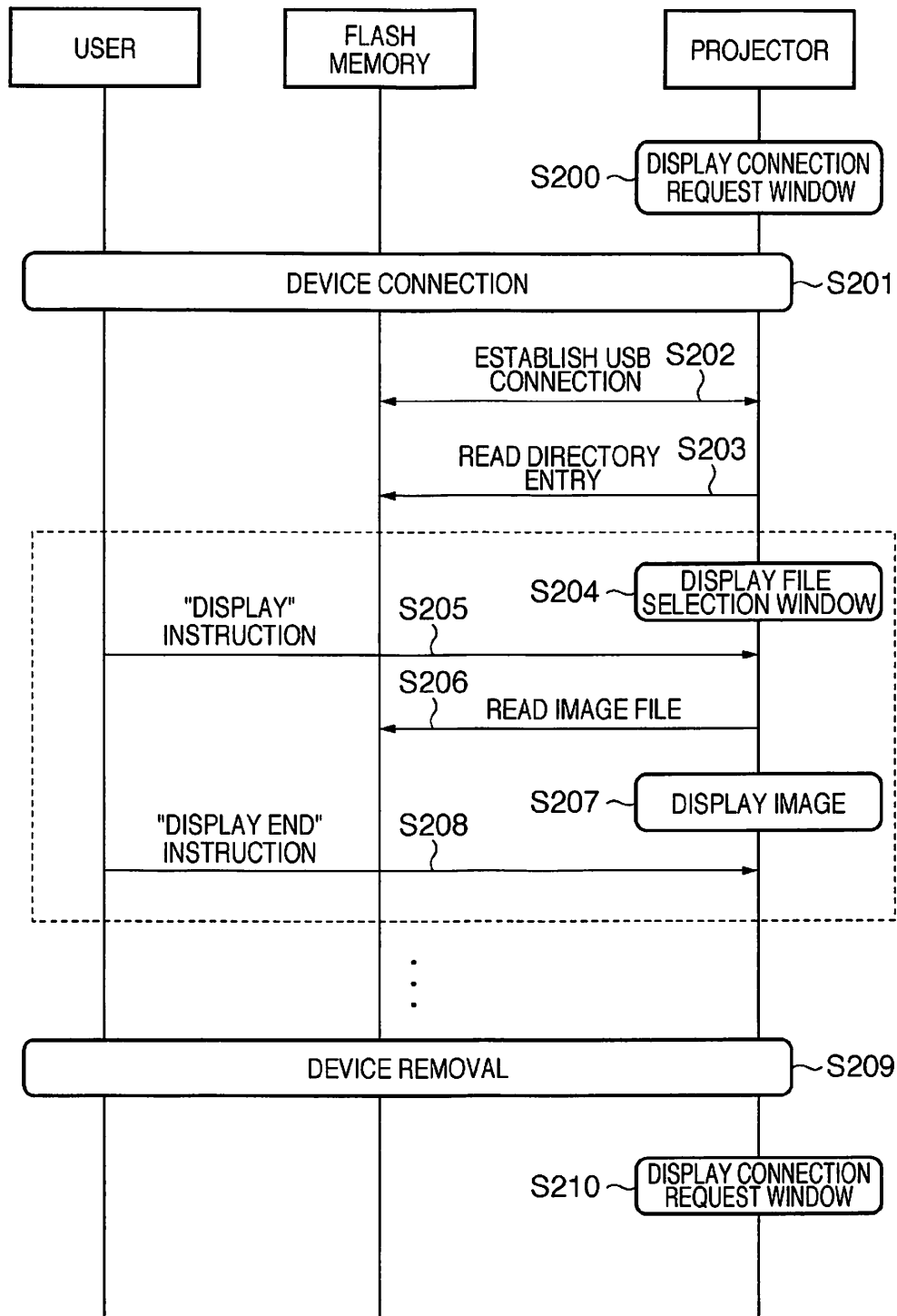


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FIG. 12

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FIG. 13A

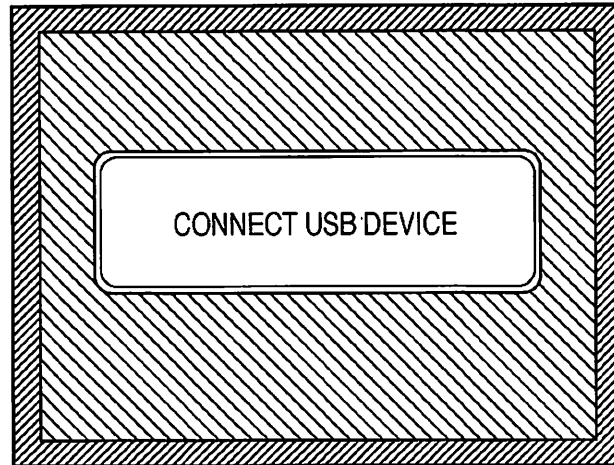


FIG. 13B

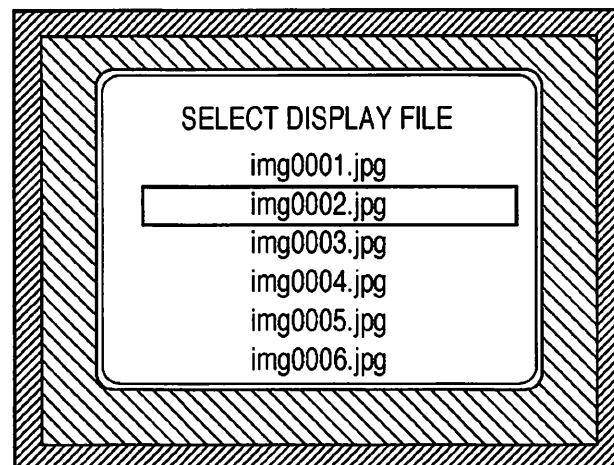
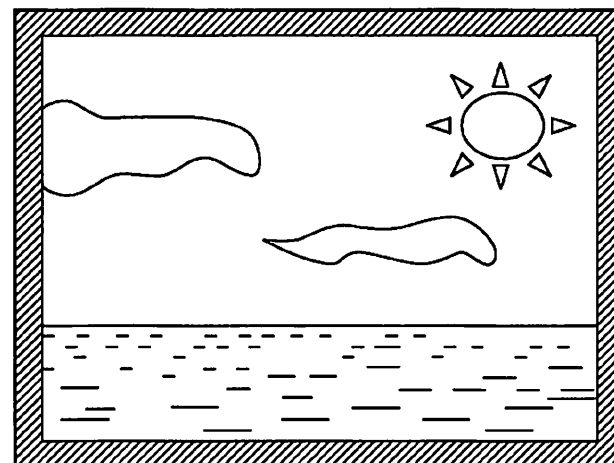


FIG. 13C



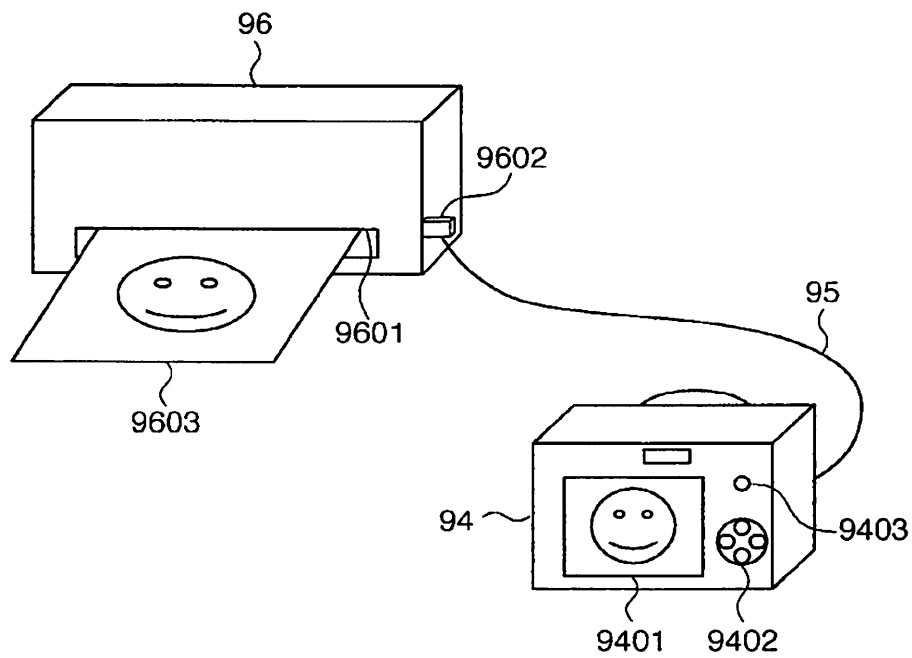
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FIG. 14A



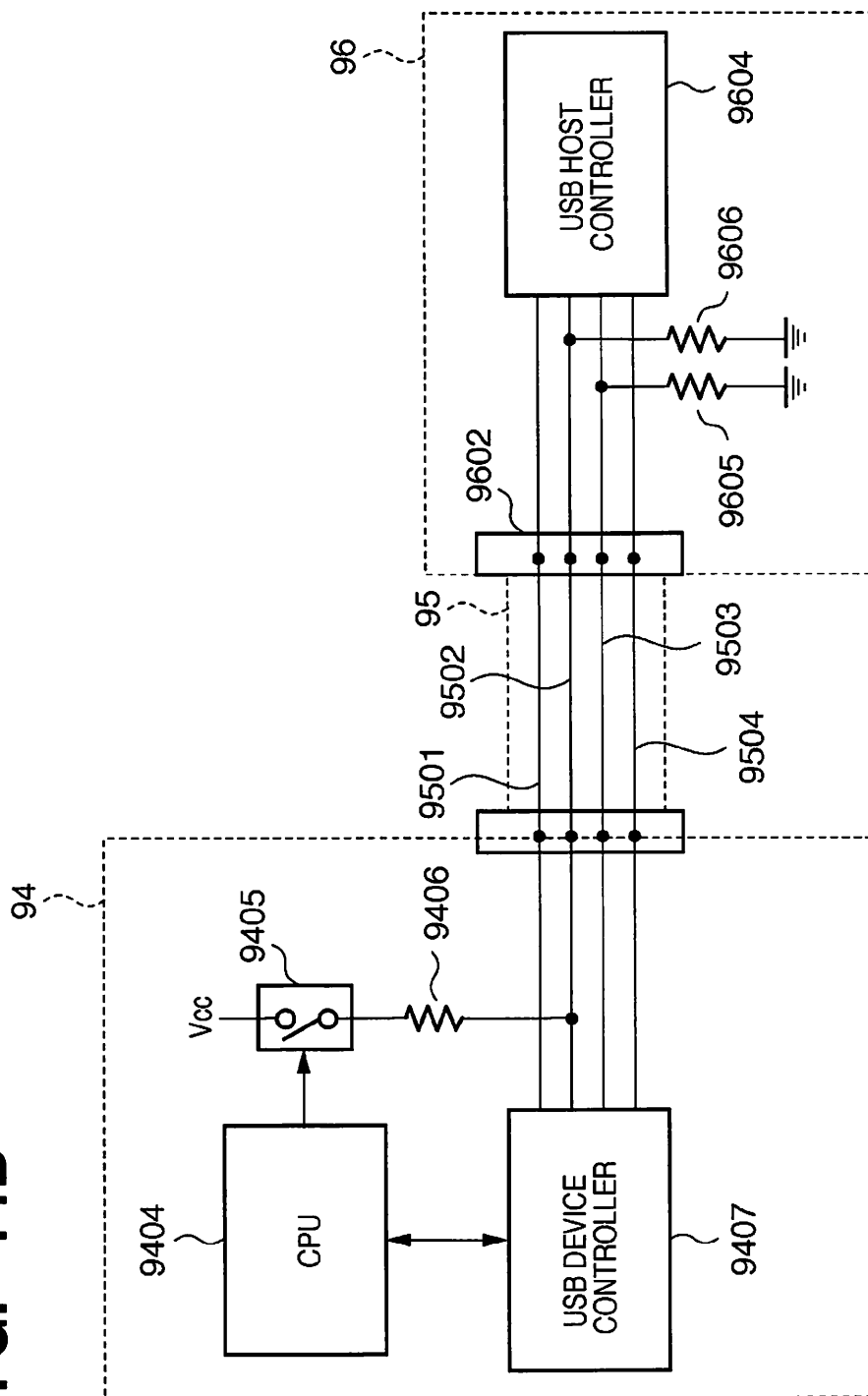
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FIG. 14B

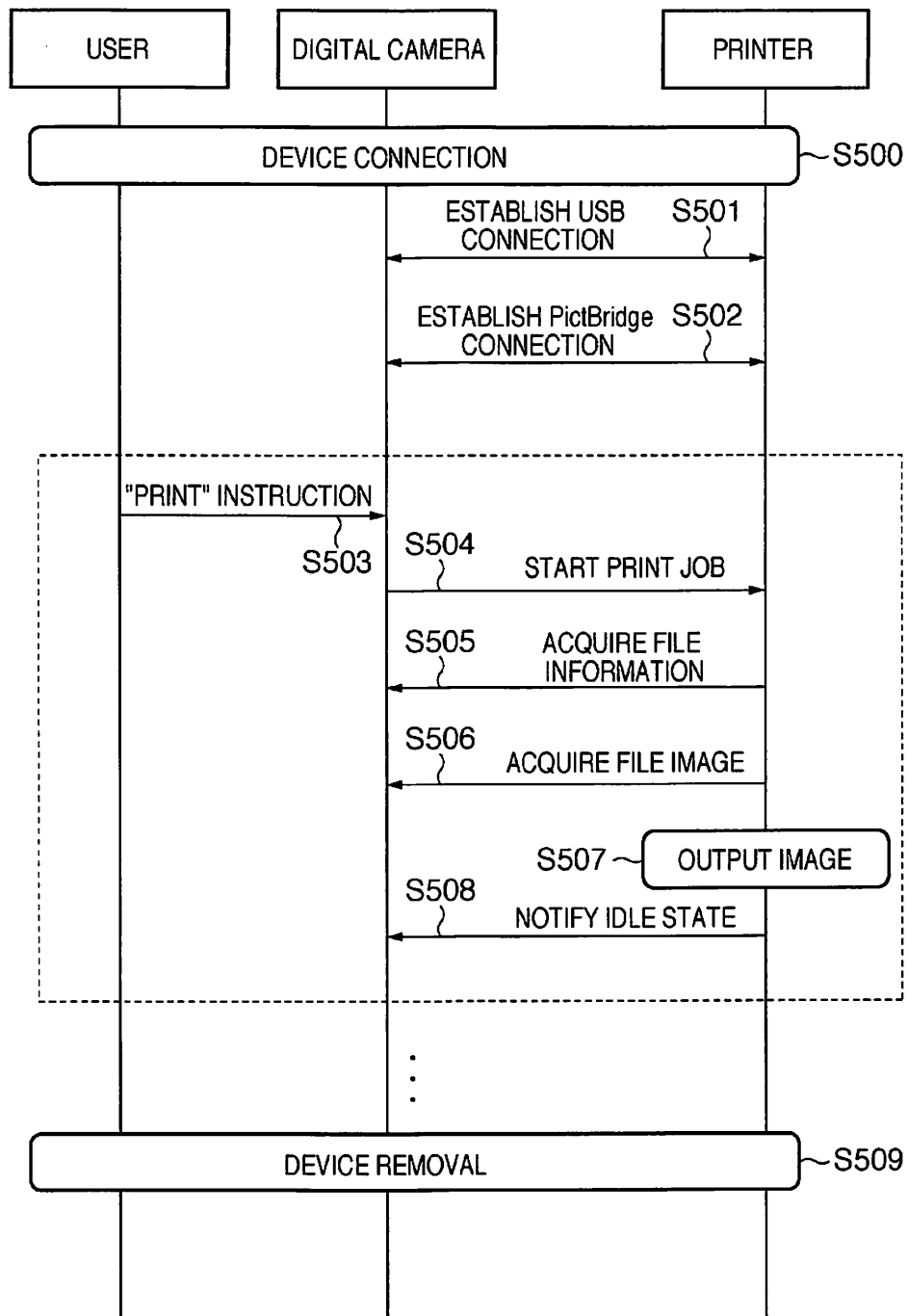


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FIG. 15

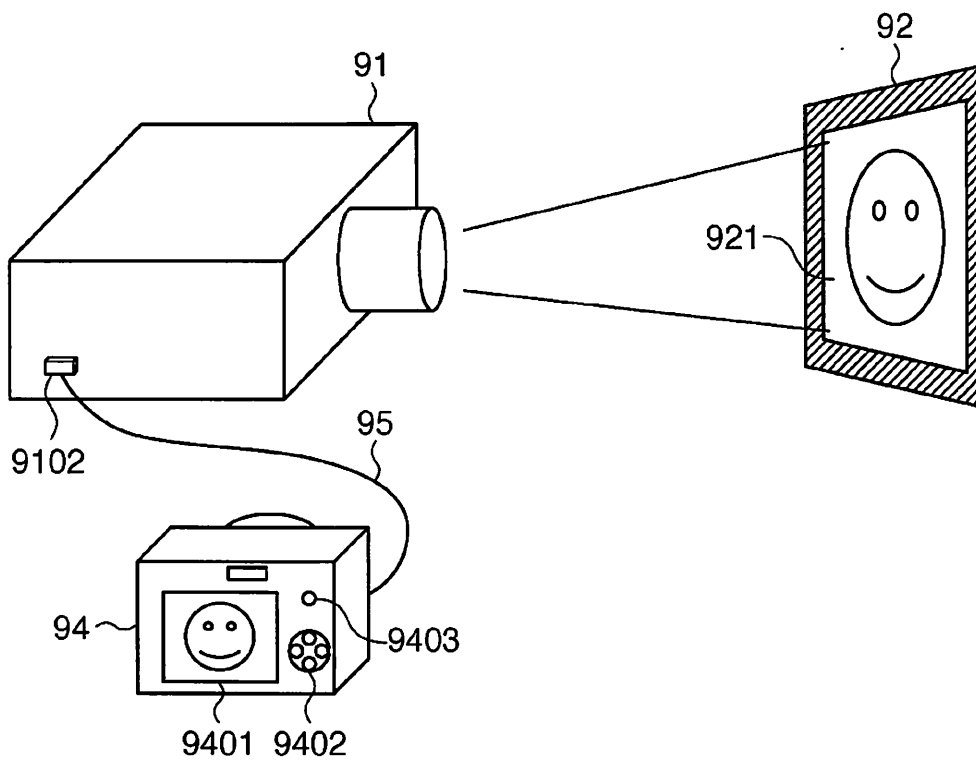
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FIG. 16



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**DISPLAY APPARATUS, CONTROL METHOD
THEREOF, AND PROGRAM**

This application is a divisional of application Ser. No. 12/545,270, filed Aug. 21, 2009, which is a continuation of PCT Application No. PCT/JP/2009/055831, filed Mar. 24, 2009.

TECHNICAL FIELD

The present invention relates to a display apparatus, a control method thereof, and a program.

BACKGROUND ART

Conventionally, a display apparatus such as a projector is connected to various devices via, for example, USB (Universal Serial Bus), and displays image data transmitted from these connected devices. Various devices connected to the display apparatus include a semiconductor memory device such as a flash memory device, a PC (Personal Computer), a digital still camera (to be referred to as a "digital camera" hereinafter), and the like.

A case will be explained first with reference to FIGS. 11A to 13C wherein a flash memory as a semiconductor memory device is connected to a projector as a display apparatus, and image data stored in that flash memory is displayed on the projector. FIG. 11A is a schematic view showing an overview when a flash memory 93 is connected to a conventional projector 91 to display an image. FIG. 11B is a schematic view showing details of a control panel 9101. FIG. 12 is a sequence chart showing the operation sequence executed when the flash memory 93 is connected to the projector 91 to display an image. FIGS. 13A to 13C are schematic views exemplifying images to be projected by the projector 91 onto a screen 92.

As shown in FIG. 11A, the projector 91 has the control panel 9101 and a USB connector 9102. As shown in FIG. 11B, the control panel 9101 has an up arrow button 9011, left arrow button 9012, down arrow button 9013, right arrow button 9014, enter button 9015, input button 9016, and power button 9017. The projector 91 accepts operation instructions from the user from various buttons on the control panel 9101. The USB connector 9102 receives the flash memory 93 having a USB connection terminal. This flash memory 93 stores image data to be displayed by the projector 91. By the user plugging the flash memory 93 into the USB connector 9102 and operating the control panel 9101, he or she can browse image data stored in the flash memory 93 as an image 921 on the screen 92.

The operation sequence among the user, flash memory 93, and projector 91 will be described below. Assume that the projector 91 is powered, and the flash memory 93 is not connected to the projector 91 in an advance state. As shown in FIG. 12, the operation sequence by the user, flash memory 93, and projector 91 mainly include steps S200 to S210 which are executed in turn. In step S200, the projector 91 displays a connection request window that requests the user to connect the flash memory 93 to the USB connector 9102 by projecting that window on the screen 92. The connection request window in step S200 displays a message that prompts the user to connect the flash memory 93 as a USB device, as shown in FIG. 13A.

In step S201, the user connects the flash memory 93 to the USB connector 9102. In step S202, a USB communication is established based on the USB standard between the projector 91 and flash memory 93 which are physically connected via

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the USB connector 102. In this case, the projector 91 recognizes the flash memory 93 as Mass Storage Class based on the USB standard.

In step S203, the projector 91 reads directory entry information stored in the flash memory 93. In step S204, the projector 91 displays a file selection window that prompts the user to select an image file to be displayed by projecting that window on the screen 92. The file selection window in step S204 is as shown in FIG. 13B, and is a window that displays a file name list of image files stored in the flash memory 93, and a cursor used to select them.

In step S205, the user who confirmed the aforementioned file selection window selects an image file to be displayed by operating the control panel 9101 and issues a display instruction to the projector 91. For example, in step S205 the user gives an instruction to move the cursor by pressing the up or down arrow button 9011 or 9013 on the control panel 9101, and issues a display instruction of an image file selected by the cursor by pressing the enter button 9015.

In step S206, the projector 91 reads data of the image file designated in step S205 from the flash memory 93. In step S207, the projector 91 displays an image based on the image file read in step S206 by projecting that image on the screen 92. As the image displayed in step S207, image data of a landscape or the like captured using a digital camera is stored in advance in the flash memory 93, as shown in FIG. 13C.

In step S208, the user issues a display end instruction to the projector 91 by operating the control panel 9101. More specifically, when the user presses the enter button 9015, a display end instruction is issued to the projector 91. Note that the operations for accepting selection of an image file by the user and displaying the selected image file can be repeated by repeating steps S204 to S208 bounded by the broken line in FIG. 12.

In step S209, the user removes the flash memory 93 from the USB connector 9102. In step S210, the projector 91 clears a display image projected onto the screen 92 (or overwrites the image by a predetermined image such as a menu window) due to removal of the flash memory 93 in step S209. For example, in step S210 the connection request window shown in FIG. 13A is overwritten on an image displayed in steps S204 to S208. As a result, the projector 91 can prompt the user to connect the next device. The user removes the flash memory 93 with the intention to end browsing of image files stored in the flash memory 93. Therefore, since the projector 91 clears an image displayed in steps S204 to S208, it can attain an image display operation according to the user's intention.

Note that patent reference 1 is known as a technique of clearing (overwriting) a display image by a predetermined image in step S210 above. Patent reference 1 discloses a technique for clearing a display image at the end of a communication and a technique for clearing a previous display image at the beginning of a communication.

A case will be exemplified below wherein another example of various devices to be connected is a digital camera. Note that a case will be exemplified below with reference to FIGS. 14A and 14B, and FIG. 15 wherein a digital camera is connected to a printer, and the printer outputs an image based on image data stored in that digital camera. As a typical example in this case, the CIPA DC-001-2003 standard (to be referred to as "PictBridge" hereinafter) is available. In a method of outputting an image using this PictBridge, even a user unskilled in operations of devices such as PCs can output an image using a printer by readily operating a digital camera. An image output operation using the PictBridge will be described below.

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FIG. 14A is a schematic view showing an overview when a digital camera 94 is connected to a printer 96 to output an image. FIG. 14B is a block diagram showing the arrangement associated with a communication between the printer 96 and digital camera 94. FIG. 15 is a sequence chart showing the operation sequence when the digital camera 94 is connected to the printer 96 to output an image.

As shown in FIG. 14A, the printer 96 has a discharge port 9601 and USB connector 9602. The discharge port 9601 discharges a paper sheet 9603 after image formation. To the USB connector 9602, the digital camera 94 is connected via a USB cable 95. The digital camera 94 has a liquid crystal panel screen 9401, operation member 9402, and PictBridge button 9403. The liquid crystal panel screen 9401 displays a preview of an image or the like transferred via the PictBridge. The operation member 9402 accepts an image selection instruction from the user. The PictBridge button 9403 is a button which accepts an instruction to start PictBridge transfer from the user. An image based on image data stored in the digital camera 94 is output onto a paper sheet in the printer 96 in such a manner that an image output instruction is output to the printer 96 by an operation on the digital camera 94 side, and image data to be output is transmitted from the digital camera 94 to the printer 96.

The operation sequence among the user, digital camera 94, and printer 96 will be described below. As shown in FIG. 15, the operation sequence by the user, digital camera 94, and printer 96 mainly includes steps S500 to S509, which are executed in turn. In step S500, the user connects the digital camera 94 and printer 96 via the USB cable 95. In step S501, a USB communication is established based on the USB standard between the digital camera 94 and printer 96 which are physically connected via the USB cable 95. In this case, the printer 96 recognizes the digital camera 94 as a capture device of Imaging Class based on the USB standard.

In step S502, a PictBridge connection is established between the digital camera 94 and printer 96. More specifically, a connection is established in a PTP (Picture Transfer Protocol) layer, device information is exchanged, and so forth. Then, a communication state as a PictBridge sequence transits to an idle state, and the printer 96 waits for issuance of a print job by the digital camera 94.

In step S503, the user issues a print instruction via the PictBridge by operating the digital camera 94. More specifically, this print instruction in step S503 is issued when the user presses the PictBridge button 9403. In step S504, the digital camera 94 transmits a PictBridge print job to the printer 96 based on the print instruction in step S503, and the printer 96 starts the operation of that print job.

In step S505, the printer 96 requests the digital camera 94 to transmit file information to be printed in accordance with the print job in step S504, and acquires that file information. Likewise, in step S506 the printer 96 requests the digital camera 94 to transmit a file image (image data) to be printed in accordance with the print job in step S504, and acquires that file image.

In step S507, the printer 96 executes decoding, scaling, print processing, and the like of an image indicated by the file acquired in steps S505 and S506, and outputs the paper sheet 9603 after image formation from the discharge port 9601. In step S508, the printer 96 notifies the digital camera 94 of an idle state upon completion of the print job. Note that the operations for accepting selection of an image to be printed from the user, and printing out the selected image can be repeated by repeating steps S503 to S508 bounded by the broken line in FIG. 15.

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In step S509, the user removes the USB cable 95 from the printer 96 or digital camera 94. Note that a device, which can control a communication session and logically disconnects a communication connection like the digital camera 94, often disconnects a communication like closing of a communication session in addition to a physical communication disconnection by, for example, removal of the USB cable 95. For example, when the battery remaining amount lowers during the aforementioned PictBridge sequence, the digital camera 94 side may execute control for disconnecting a USB communication so as to reduce consumption power.

A communication disconnection on the digital camera 94 side will be explained below by exemplifying the arrangement associated with a communication between the digital camera 94 and printer 96. As shown in FIG. 14B, a USB host controller 9604 on the printer 96 side is connected to a USB device controller 9407 on the digital camera 94 side via the USB cable 95. The USB cable 95 includes four signal lines, that is, a VBUS line 9501, D+ line 9502, D- line 9503, and GND line 9504.

The D+ line 9502 and D- line 9503 are used to transmit differential signals required to make a USB data communication, and also indicate a device connection state by a voltage in a steady state. The D+ line 9502 and D- line 9503 are respectively pulled down by resistors 9606 and 9605 on the printer 96 side, and indicate a Low voltage when no USB cable is connected. Thus, the printer 96 recognizes a USB non-connection state. On the other hand, when the printer 96 and digital camera 94 are connected, the D+ line 9502 is pulled up by a resistor 9406 via a switch 9405 on the digital camera 94 side. Then, when the switch 9405 is in a connection state, the D+ line 9502 indicates a High voltage. As a result, the printer 96 recognizes a USB connection state.

A CPU 9404 controls the switch 9405 on the digital camera 94 side. Note that the CPU 9404 executes the following processing for the purpose of, for example, reducing consumption power of the digital camera 94. For example, in step S508 in which the PictBridge sequence transits to an idle state upon completion of the print job, the CPU 9404 controls the switch 9405 on the digital camera 94 side to stop to pull up the D+ line 9502. In this case, the D+ line 9502 indicates a Low voltage since it is pulled down on the printer 96 side. For this reason, the USB host controller 9604 recognizes a USB non-connection state and disconnects a USB communication, since this state is electrically equivalent to cable removal in association with the D+ line 9502. That is, the communication session between the digital camera 94 and printer 96 is closed by the control on the digital camera 94 side for the purpose of, for example, reducing consumption power.

When a communication disconnection is made on the digital camera 94 side, as described above, the user meets the same behavior as that when the USB cable 95 is removed at the end of the print processing of the printer 96. That is, the PictBridge sequence reaches the same state as that when the process reaches step S509.

Note that the PictBridge that assumes printing has been exemplified, but the PictBridge is applicable to a display on a display apparatus such as a projector or television. For example, when the digital camera 94 is connected to the projector 91 to display an image, as shown in FIG. 16, the PictBridge allows the projector 91 to project and display an image transmitted from the digital camera 94 by a simple operation on the digital camera 94 side. Like in the case in which the printer 96 and digital camera 94 are connected, when a communication is disconnected on the digital camera 94 side, the user meets the same behavior as that when the USB cable 95 is removed. That is, the projector 91 clears an

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image which was transmitted from the digital camera 94 and was displayed immediately before the communication disconnection by displaying, for example, the connection request window.

As a technique for disconnecting a USB communication from the device side, patent reference 2 is known. Patent reference 2 discloses a technique for disconnecting a communication by stopping to pull up a data line on the device side based on a disconnection instruction from the host side. Patent Reference 1: Japanese Patent Laid-Open No. 7-123379

Patent Reference 2: Japanese Patent Laid-Open No. 2006-235993

DISCLOSURE OF THE INVENTION

Problems that the Invention is to Solve

As described above, the conventional display apparatus can be connected to various devices, and can display image data stored in a connected device. However, independently of the device class to be connected, when a communication is disconnected, the display operation of an image transmitted from that device ends. For this reason, in addition to the image display end operation that the user intended by removing the flash memory or USB cable, the image display operation often ends without the intention of the user by the control on the device side that logically disconnects a communication connection.

The present invention handles at least one of such conventional problems. That is, the present invention provides a display apparatus, which can control to continue or end a display operation according to a device class when a communication connection with a device is disconnected during execution of the display operation based on data transmitted from the connected device, a control method thereof, and a program.

Means of Solving the Problems

According to the first invention of the present application, there is provided a display apparatus characterized by comprising a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, characterized in that the control unit acquires class information indicating a class of the external device from the external device via the connection unit, controls the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the second invention of the present application, there is provided a control method of a display apparatus which comprises a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection

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is established via the connection unit, the method characterized by comprising the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the third invention of the present application, there is provided a display apparatus characterized by comprising a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, characterized in that the control unit acquires class information indicating a class of the external device from the external device via the connection unit, controls the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the fourth invention of the present application, there is provided a control method of a display apparatus which comprises a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, the method characterized by comprising the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

Effects of the Invention

According to the present invention, when a communication connection with a device is disconnected during execution of a display operation based on data transmitted from the connected device, the display operation can be controlled to continue or end according to the device class.

Other features and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings. Note that the

same reference numerals denote the same or similar components throughout the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. 1A is a view exemplifying a use mode of a display apparatus according to the present invention, that is, a schematic view exemplifying a use mode upon connecting a flash memory to a display apparatus to display an image;

FIG. 1B is a view exemplifying a use mode of the display apparatus according to the present invention, that is, a schematic view exemplifying a use mode upon connecting a digital camera to the display apparatus to display an image;

FIG. 2 is a block diagram illustrating the functional arrangement of the display apparatus;

FIG. 3 is a schematic view exemplifying an input selection menu window;

FIG. 4A is a flowchart showing the processing of the display apparatus:
FIG. 4A is a flowchart showing the processing of the display apparatus when "Mass Storage Class" is determined in step S804 in FIG. 4A:
FIG. 4B is a flowchart showing the sequel of FIG. 4B1.
FIG. 4C1 is a flowchart showing the processing of the display apparatus when "Imaging Class" is determined in step S804 in FIG. 4A:

FIG. 4C2 is a flowchart showing the sequel of FIG. 4C1: projected display window, that is, a schematic view exemplifying an input waiting window;

FIG. 5B is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying a display of image data from the digital camera;

FIG. 5C is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying an incompatibility window;

FIG. 6A is a flowchart showing processing of the first modification (corresponding to FIG. 4C1) in the display apparatus:
FIG. 6B is a flowchart showing processing of the first modification (corresponding to FIG. 4C2) in the display apparatus:
FIG. 7 is a block diagram showing the peripheral arrangement of a CPU and USB connector 102 of the second modification in the display apparatus:

FIG. 8A is a flowchart showing processing of the second modification (continued from any of FIGS. 8B1 to 8C2) in the display apparatus: FIG. 8B1 is a flowchart showing processing of the second modification (corresponding to FIG. 4B1) in the display apparatus: FIG. 8B2 is a flowchart showing processing of the second modification (corresponding to FIG. 4B2) in the display apparatus:

FIG. 8C1 is a flowchart showing processing of the second modification (corresponding to FIG. 4C1) in the display apparatus;
FIG. 8C2 is a flowchart showing processing of the second modification (corresponding to FIG. 4C2) in the display apparatus;
FIG. 9A is a flowchart showing processing of the third modification (corresponding to FIG. 8A) in the display apparatus;

FIG. 9B is a flowchart showing processing of the third modification (corresponding to FIG. 4A) in the display appa-

FIG. 10A is a flowchart showing processing of the fourth modification (corresponding to FIG. 9A) in the display apparatus:
 FIG. 10B is a flowchart showing processing of the fourth modification (corresponding to FIG. 9B) in the display apparatus:

Flash memory 11A is a schematic view showing an overview when a display an image:
FIG. 11B is a schematic view showing details of a control panel:
FIG. 12 is a sequence chart showing the operation sequence when the flash memory is connected to the projector

FIG. 13A is a schematic view exemplifying a connection request window projected by the projector onto a screen; FIG. 13B is a schematic view exemplifying a file selection window projected by the projector onto the screen; FIG. 13C is a schematic view exemplifying a display of image data which is stored in the flash memory, and is projected by the projector onto the screen.

FIG. 14A is a schematic view showing an overview when a digital camera is connected to a printer to output an image; FIG. 14B is a block diagram showing the arrangement associated with a communication between the printer and digital camera; FIG. 15 is a sequence chart showing the operation sequence when the digital camera is connected to the printer to output an image; and FIG. 16 is a schematic view showing an overview when a digital camera is connected to a projector to display an image.

DESCRIPTION OF REFERENCE NUMERALS

- 1 . . . display apparatus
- 2 . . . screen
- 3 . . . flash memory
- 4 . . . digital camera
- 5 . . . USB cable

BEST MODE FOR CARRYING OUT THE INVENTION

An embodiment of the present invention will be described hereinafter with reference to the drawings, but the present invention is not limited to the embodiment to be described hereinafter. The embodiment of the present invention presented herein is one aspect of the invention, and does not limit the scope of the invention.

A use mode of a display apparatus according to the present invention will be described first with reference to FIGS. 1A and 1B which exemplify the use modes of a display apparatus 1. As shown in FIG. 1A, as a use mode of the display apparatus 1, a flash memory 3 is connected to a USB connector 102 of the display apparatus 1, and an image stored in the flash memory 3 is projected and displayed as an image 21 on a screen 2. A control panel 101 includes various buttons used to

Also, as shown in FIG. 1B, as another use mode, a digital display apparatus 1 via a USB cable 5, and an image stored in camera 4 is connected to a USB connector 102 of the USB connector 102 and operating the control panel 101.

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the digital camera 4 is projected and displayed as an image 22 on the screen 2. The digital camera 4 has a liquid crystal panel screen 401, operation member 402, and operation button 403. The liquid crystal panel screen 401 displays a preview of an image and the like to be transferred to the display apparatus 1. The operation member 402 accepts a selection instruction of an image from the user. The operation button 403 is a button used to accept a transfer start instruction to the display apparatus 1 from the user. A projection display operation by the display apparatus 1 based on image data stored in the digital camera 4 is attained in such a manner that an image display instruction by an operation on the digital camera 4 side is output from the digital camera 4 to the display apparatus 1, and image data to be output is transmitted from the digital camera 4 to the display apparatus 1.

The user who uses the display apparatus 1 can appreciate an image captured by the digital camera 4 by projecting and displaying it onto the screen or can make a presentation for other users by projecting an image which is saved in the flash memory 3 and represents briefing paper.

Details of the display apparatus 1 will be described below with reference to FIG. 2. FIG. 2 is a block diagram illustrating the functional arrangement of the display apparatus 1. As shown in FIG. 2, a video signal is input to a video terminal 103 particularly via a video cable (not shown). The input video signal is converted into a digital video signal by an AD converter 104 (Analog-To-Digital) connected to the video terminal 103. A CPU 107 (to be described later) sets sampling parameters (a frequency, phase, etc.) upon AD conversion. Note that when an input video signal is a digital video signal, the AD converter 104 is not required, and the present invention is applicable when an appropriate receiver is used as needed.

The converted digital video signal is input to a video processor 105 connected to the AD converter 104. The video processor 105 applies video adjustment processing such as resolution conversion processing, contrast adjustment, and brightness, sharpness, and gamma corrections, and OSD image superimposing processing of a menu and the like. Note that "OSD" is an abbreviation for "On Screen Display".

The CPU 107 controls the operation of the video processor 105. Furthermore, the video processor 105 can receive arbitrary image data from the CPU 107. For example, when the CPU 107 transmits image data received by a USB host controller 110 to the video processor 105, the video processor 105 can output that video as a video signal.

The video signal output from the video processor 105 is input to a liquid crystal driver 106, and is converted into signals (e.g., RGB video signals) suited to drive liquid crystal panels 117, 118, and 119. The liquid crystal panels 117, 118, and 119, which respectively represent three primary colors, that is, Red, Green, and Blue, include liquid crystal pixels arranged in a matrix pattern, and form images based on input signals. The liquid crystal panels 117, 118, and 119 are arranged to transmit light emitted from a lamp (not shown) through them, and modulate light coming from the lamp by images formed based on the input signals.

A projection lens 120 projects and displays light modulated by the liquid crystal panels 117, 118, and 119 onto an external device (e.g., the screen 2). The control panel 101 has an up arrow button, left arrow button, down arrow button, right arrow button, enter button, input button, and power button as in the control panel 9101 that has been explained with reference to FIG. 11B. Pressing information of each button on the control panel 101 is sent to the CPU 107 as an operation instruction by the user. More specifically, that infor-

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mation is used to control a cursor movement, an enter operation, and the like of a menu on a display window.

The USB host controller 110 is a circuit which makes a USB communication with an external device using a VBUS line 111, D+ line 112, D- line 113, and GND line 114, which are specified in the USB standard. In the USB host controller 110, data to be transmitted/received is input/output by the CPU 107. The D+ line 112 and D- line 113 are USB communication lines used to make a differential communication, and are respectively pulled down by resistors 115 and 116. The VBUS line 111, D+ line 112, D- line 113, and GND line 114 are connectable to an external device via the USB connector 102 as a connection unit. The USB connector 102 serves as a USB interface which can connect a USB device as an external device. Therefore, the display apparatus 1 and USB device can communicate with each other via the USB connector 102.

The CPU 107 (Central Processing Unit) centrally controls the display apparatus 1. More specifically, the CPU 107 manages to start up and shut down the display apparatus 1, and controls the respective units such as the AD converter 104, video processor 105, USB host controller 110, and liquid crystal driver 106. A ROM 108 (Read Only Memory) stores program codes and various data required to operate the CPU 107. A CPU 107 (Random Access Memory) provides a work area required to let the RAM 109 operate.

The CPU 107 can select a video source to be displayed from the following two sources in addition to the startup processing of respective blocks after power-ON. The first video source is a video picture signal input from the video terminal 103. The second video source is image data transmitted from a device connected via the USB connector 102. The CPU 107 controls the video processor 105 to project an input selection menu window in response to a user's operation on the control panel 101 as a trigger. FIG. 3 is a schematic view exemplifying the input selection menu window. As shown in FIG. 3, the input selection menu window presents a selection menu of "external video" and "USB" as a video source to be displayed to the user.

After that, the CPU 107 receives a selection instruction input by a user's operation on the control panel 101, and executes a video source switching operation. In this video source switching operation, when "USB" is selected, and the projection display operation of image data from the flash memory 3 or digital camera 4 connected to the display apparatus 1 is to be executed, the CPU 107 sequentially executes the flowcharts including steps S801 to S832 exemplified in FIGS. 4A to 4C2. The processing of these flowcharts is executed until the power switch of the display apparatus 1 is turned off or until the input selection menu is displayed again, and "external video" is selected as a video source.

As shown in FIGS. 4A to 4C2, if the processing is started (S801), the CPU 107 controls the video processor 105 to project and display a USB device connection request window onto the screen 2 (S802). This connection request window is as has been described with reference to FIG. 13A, and prompts the user to connect a USB device. The connection request window is a kind of pattern image, and is displayed based on pattern image data stored in advance in the ROM 108.

The CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB device is communication-connected via the USB connector 102, and a USB communication is established (S803). If it is determined in step S803 that a USB communication is established, the process to be executed by the CPU 107 advances to the next step.

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The CPU 107 sends an inquiry to the USB host controller 110 to determine a class of the communication-connected USB device (S804). This class is determined based on class information transmitted from the USB device when the USB host controller 110 establishes a USB communication with that USB device connected via the USB connector 102. More specifically, the class information of the USB device includes USB Mass Storage Class indicating the class of a device which is a simple storage and physically disconnects a communication connection. Also, the class information includes USB Imaging Class (often also called Imaging Device) indicating the class of a device which can execute communication control with the connected display apparatus 1 and can logically disconnect a communication connection depending on devices. Note that USB Mass Storage Class will be referred to as Mass Storage Class, and USB Imaging Class will be referred to as Imaging Class hereinafter. For example, the flash memory 3 transmits class information indicating Mass Storage Class to the display apparatus 1 at the time of connection, and the digital camera 4 transmits class information indicating Imaging Class to the display apparatus 1 at the time of connection. If the class information indicates Mass Storage Class in step S804, the process to be executed by the CPU 107 advances to step S805; if the class information indicates Imaging Class, the process advances to step S817; otherwise, the process advances to step S831.

FIG. 4A shows "Mass Storage Class" and "Imaging Class" as the device classes, but the present invention is not limited to these classes. For example, the display apparatus 1 may store a class for which an image display operation is to be continued and a class for which the operation is to be ended (or one of these classes) at the time of disconnection of a communication.

The CPU 107 executes a sequence of steps S805 to S816 when the communication-connected USB device is a USB mass storage such as the flash memory 3. In step S805, the CPU 107 reads out directory entry information stored in the USB device via the USB host controller 110.

In step S806, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S805 in this case). If it is determined in step S806 that the USB communication was disconnected, the process to be executed by the CPU 107 returns to step S802.

In step S807, the CPU 107 controls the video processor 105 to display a file selection window that enumerates image file names based on the readout directory entry information. This file selection window is as has been described with reference to FIG. 13B, and is a window that displays a file name list of image files stored in the flash memory 3 and a cursor used to select them. The display apparatus 1 prompts the user to select an image file to be displayed of those stored in the flash memory 3 using this file selection window.

The CPU 107 determines in step S808 whether or not a USB communication with the USB device was disconnected, as in step S806. The CPU 107 determines in step S809 whether or not the user has made an operation on the control panel 101. If it is determined in step S809 that the user has not made any operation, the process to be executed by the CPU 107 returns to step S808.

In step S810, the CPU 107 updates the file selection window based on the user's operation on the control panel 101. More specifically, when the user presses the up or down arrow button on the control panel 101, the CPU 107 reconfigures and displays a window on which the cursor to be rendered to select a file of interest has been moved.

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The CPU 107 determines in step S811 based on a user's operation on the control panel 101 whether or not the user has made an operation to select an image file to be displayed. More specifically, when the user presses the enter button on the control panel 101, the CPU 107 determines that an image file in a cursor line is determined as that to be displayed. If no image file selection operation is made, the process to be executed by the CPU 107 returns to step S808.

In step S812, the CPU 107 reads out a file image of the image file selected in step S811 from the USB device via the USB host controller 110. The CPU 107 determines in step S813 whether or not a USB communication with the USB device was disconnected, as in step S806.

In step S814, the CPU 107 controls the video processor 105 to project and display an image based on the readout file image on the screen 2, after the image is scaled to match the resolution of the liquid crystal panels 117, 118, and 119. The image which is projected and displayed on the screen 2 is the same as that which has been described with reference to FIG. 13C, and is based on image data stored in advance in the flash memory 3.

The CPU 107 determines in step S815 whether or not a USB communication with the USB device was disconnected, as in step S806. The CPU 107 determines in step S816 based on a user's operation on the control panel 101 whether or not the user gives the instruction to end the image display operation. More specifically, the CPU 107 makes this determination by acquiring pressing information of the enter button on the control panel 101. If the user does not give the instruction to end the image display operation, the process to be executed by the CPU 107 returns to step S815. If the user gives the instruction to end the image display operation, the process to be executed by the CPU 107 returns to step S807, and the file selection window is displayed again to prompt the user to select another image file.

On the other hand, the CPU 107 executes a sequence of steps S817 to S830 when the connected USB device corresponds to, for example, Imaging Class such as the digital camera 4 compatible to the PictBridge. Note that the PictBridge-compatible digital camera 4 will be exemplified below, and a case will be described wherein the scheme of the PictBridge is diverted, and the projection display operation of the display apparatus 1 is made using a print instruction (image output) from the digital camera 4. In step S817, the CPU 107 executes PictBridge connection processing with respect to the USB device via the USB host controller 110. Note that this processing corresponds to step S502, which has been explained with reference to FIG. 15.

In step S818, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S817 in this case). If it is determined in step S818 that the USB communication was disconnected, the process to be executed by the CPU 107 advances to step S830.

The CPU 107 determines in step S819 whether or not the PictBridge connection processing in step S817 has succeeded, and a PictBridge connection is established. If a PictBridge connection is not established because, for example, the USB device to be connected is incompatible to the PictBridge, the process to be executed by the CPU 107 advances to step S831.

In step S820, the CPU 107 controls the video processor 105 to project and display an input waiting window. This input waiting window is a window used to prompt the user to print an image file (or to transfer an image to a projector) by the PictBridge function from the digital camera side, as shown in FIG. 5A. Note that this step S820 corresponds to an idle state

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in which the control waits for a "print" instruction in step S503 described with reference to FIG. 15.

The CPU 107 determines in step S821 whether or not a USB communication with the USB device was disconnected, as in step S818. The CPU 107 determines in step S822 whether or not a print job start communication is made from the USB device via the USB host controller 110. This communication corresponds to step S504 which has been explained with reference to FIG. 15. If it is determined in step S822 that no start instruction is issued, the process to be executed by the CPU 107 returns to step S821.

The CPU 107 determines in step S823 whether or not a USB communication with the USB device was disconnected, as in step S818. In step S824, the CPU 107 acquires information of an image file to be output included in the print job from the USB device via the USB host controller 110. This step S824 corresponds to step S505 which has been described with reference to FIG. 15.

The CPU 107 determines in step S825 whether or not a USB communication with the USB device was disconnected, as in step S818. In step S826, the CPU 107 acquires an image of the image file included in the print job from the USB device via the USB host controller 110. This step S826 corresponds to step S506 which has been described with reference to FIG. 15.

The CPU 107 determines in step S827 whether or not a USB communication with the USB device was disconnected, as in step S818. In step S828, the CPU 107 controls the video processor 105 to project and display the acquired image on the screen 2, after the image is scaled to match the resolution of the liquid crystal panels 117, 118, and 119. The image, which is projected and displayed on the screen 2, is an image based on image data captured by the digital camera, and is an image of a person or the like, as shown in, for example, FIG. 5B.

In step S829, the CPU 107 notifies the USB device, via the USB host controller 110, that a communication state based on the PictBridge connection transits to an idle state. This notification in step S829 corresponds to step S508 which has been described with reference to FIG. 15.

If it is determined in step S818, S821, S823, S825, or S827 that the USB communication was disconnected, the process of the CPU 107 advances to step S830. The CPU 107 determines in step S830 whether or not the projection display operation of an image based on the image acquired from the USB device is in progress (i.e., whether or not the process has passed step S828). If the projection display operation of the image is in progress, the process of the CPU 107 returns to step S803; otherwise, the process of the CPU 107 returns to step S802.

On the other hand, if an incompatible device class is determined in step S804, or if it is determined in step S819 that a PictBridge connection is not established, the process of the CPU 107 advances to step S831. In step S831, the CPU 107 controls to project and display an incompatibility window. This incompatibility window is a window used to notify the user that the connected USB device is incompatible to the display apparatus 1, as shown in FIG. 5C.

In step S832, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected. This determination in step S832 continues until the USB communication is disconnected, and if the USB communication is disconnected, the process of the CPU 107 returns to step S802.

As described above, when a USB communication is disconnected while the display apparatus 1 is connected to a USB device such as a flash memory device, and executes the

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projection display operation of image data stored in that device, the display apparatus 1 overwrites an image whose projection display operation is in progress by the connection request window (S802). When the class of the connected device corresponds to, for example, the flash memory device, the USB connection is disconnected mainly by removal of the device by the user. Furthermore, the user removes the device with the intention to end the projection display operation. Hence, when the USB connection is disconnected, it is preferable for the display apparatus 1 to overwrite an image, whose projection display operation is in progress, by the connection request window without continuing the projection display operation.

On the other hand, when a USB connection is disconnected while the display apparatus 1 is connected to a USB device such as a digital camera, and executes the projection display operation of image data stored in that device, the display apparatus 1 continues to display the image, whose projection display operation is in progress, without being overwritten by the connection request window (transition from step S830 to step S803). When the class of the connected device corresponds to, for example, the digital camera, the USB communication may be disconnected either by removal of the device by the user or by control on the USB device side. Therefore, since the USB connection is disconnected by not only removal of the device by the user who intended to end the projection display operation, it is preferable for the display apparatus 1 to continue to display an image, whose projection display operation is in progress, when the USB connection is disconnected.

That is, when a communication is disconnected while the display apparatus 1 executes the projection display operation based on image data from the connected device, the display apparatus 1 controls whether or not to continue the display operation of the image whose projection display operation is in progress according to the class of the connected device. Therefore, the display apparatus 1 can eliminate the opportunity of a display state which is likely to occur depending on the class of the connected device and is not intended by the user. For example, the display apparatus 1 can eliminate occurrence of situations that the image display operation is unwantedly ended in a case in which the user intends to browse images and that the image display operation is unwantedly continued in a case in which the user intends to end image browsing. Note that, in this embodiment, the image of the connection request window is used as an overwrite image. Alternatively, for example, a solid black or blue-black pattern image may be used.

[First Modification]

As the first modification of the aforementioned embodiment, a case will be described wherein the processes of FIGS. 4C1 and 4C2 of those to be executed by the CPU 107 of the display apparatus 1 exemplified in FIGS. 4A to 4C2 are modified like the flowcharts shown in FIGS. 6A and 6B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided.

As shown in FIGS. 6A and 6B, in the first modification, steps S818, S823, S825, and S827 in the sequence of the CPU 107 exemplified in FIGS. 4C1 and 4C2 are respectively replaced by steps S1318, S1323, S1325, and S1327.

In step S1318, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S817 in this case). If it is determined in step S1318 that the USB communication was disconnected, the process to be executed by the CPU 107 returns to step

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S802. Note that the processing contents in steps S1323, S1325, and S1327 are the same as in step S1318.

In step S821, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S820 in this case). If it is determined in step S821 that the USB communication was disconnected, the process to be executed by the CPU 107 advances to step S830. That is, when the USB communication is disconnected at the display timing of the input waiting window, and in an idle state of the communication, since the process of the CPU 107 temporarily advances to step S830, an image can be prevented from being immediately overwritten by the connection request window.

As described above, in the first modification, the following processes of the display apparatus 1 executed when a communication is disconnected while the display apparatus 1 is connected to the PictBridge-compatible device and executes the projection display operation of an image stored in that device are different from the aforementioned embodiment. When the PictBridge connection is not in an idle state, that is, a communication is underway at the time of the aforementioned communication disconnection, the display apparatus 1 overwrites an image whose projection display operation is in progress by the connection request window. When the PictBridge connection is in an idle state, that is, a communication is not underway, an image whose projection display operation is in progress is continuously displayed.

When the PictBridge connection is in a non-idle state, that is, a communication is underway, a USB communication is more likely to be disconnected at that time not by control on the USB device side but by, for example, removal of the USB device by the user. Therefore, when a communication is disconnected during the USB communication, it is preferable for the display apparatus 1 to overwrite an image, whose projection display operation is in progress, by the connection request window without continuously displaying the image. When a communication is disconnected while the USB communication is in an idle state, such disconnection may be caused either by removal of the USB device by the user or by control on the USB device side. Therefore, since a USB communication in an idle state is disconnected by not only removal of the device by the user who intends to end the projection display operation, it is preferable for the display apparatus 1 to continue to display an image whose projection display operation is in progress.

[Second Modification]

The second modification of the aforementioned embodiment will be described below. In the second modification, the peripheral arrangement of the CPU 107 and USB connector 102 of the display apparatus 1 exemplified in FIG. 2 is modified, as shown in FIG. 7. Also, in the second modification, the processes to be executed by the CPU 107 of the display apparatus 1 exemplified in FIGS. 4B1 to 4C2 are modified, as shown in the flowcharts shown in FIGS. 8A to 8C2. Note that the same reference numerals denote the same components, and a repetitive description thereof will be avoided.

As shown in FIG. 7, the display apparatus 1 includes an insertion detector 121 which detects insertion of a USB plug in the USB connector 102. In the insertion detector 121, a conductive terminal 1212 having a projection 1211, which is arranged at a position where the projection 1211 physically interferes with a USB plug, and a grounded conductive terminal 1213 are arranged in the USB connector 102 to be brought into contact with each other when a USB plug is not inserted. The conductive terminal 1212 is pulled up by a resistor 122, and is connected to an input port of the CPU 107.

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Therefore, in the insertion detector 121, when a USB plug is inserted into the USB connector 102, the USB plug pushes up the conductive terminal 1212, and the conductive terminals 1212 and 1213 are open. Hence, the CPU 107 can recognize insertion/removal of the USB plug to/from the USB connector 102.

In the second modification, steps S806, S808, S813, S815, S818, S821, S823, S825, and S827 shown in FIGS. 4B1 to 4C2 are changed, as shown in FIGS. 8B1 to 8C2, and FIG. 8A having steps S1530 and S1533 is added.

In step S1506, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S805 in this case). If it is determined in step S1506 that the USB communication was disconnected, the process to be executed by the CPU 107 advances to step S1530. Note that the processing contents in steps S1508, S1513, S1515, S1518, S1521, S1523, S1525, and S1527 are the same as in step S1506.

The CPU 107 determines in step S1530 whether or not the projection display operation of an image based on image data acquired from the USB device is in progress (that is, whether or not the process has passed step S814 or S828). If the projection display operation of the image is in progress, the process of the CPU 107 advances to step S1533; otherwise, the process of the CPU 107 returns to step S802.

The CPU 107 determines in step S1533 using the insertion detector 121 whether or not a USB plug is physically removed from the USB connector 102. If it is determined in step S1533 that the USB plug is physically removed, the process of the CPU 107 returns to step S802. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU 107 returns to step S803.

As described above, in the second modification, when the USB plug is physically removed and a USB communication is disconnected during the projection display operation of image data stored in the connected USB device, the display apparatus 1 overwrites the image whose projection display operation is in progress by the connection request window. Note that when a USB communication is disconnected not by physical removal of the USB plug, the display apparatus 1 does not overwrite the image whose projection display operation is in progress by the connection request window. Thus, the display apparatus 1 can eliminate occurrence of situations that the image display operation is unwantably ended in a case in which the user intends to browse images and that the image display operation is unwantably continued in a case in which the user intends to end image browsing.

[Third Modification]

The third modification, which further modifies the processing of the aforementioned second modification, will be described below with reference to the flowcharts shown in FIGS. 9A and 9B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided. As shown in FIGS. 9A and 9B, in the third modification, step S1533 is replaced by step S1633 in the sequence of the CPU 107 exemplified in FIG. 8A (FIG. 9A), and steps S1634 to S1636 are added in the sequence of the CPU 107 exemplified in FIG. 4A (FIG. 9B).

The CPU 107 determines in step S1633 using the insertion detector 121 whether or not a USB plug is physically removed from the USB connector 102. If it is determined in step S1633 that the USB plug is physically removed, the process of the CPU 107 returns to step S802. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU 107 advances to step S1634.

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In step S1634, the CPU 107 sets and starts a timer which performs a count-down operation for a predetermined period (second period) specified in advance in the ROM or the like. If the CPU 107 determines in step S1635 that the timer started in step S1634 reaches a time-out, or the user issues an instruction on the control panel 101, the process returns to step S802.

In step S1636, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not the USB device is connected, and a USB communication is established. If it is determined in step S1636 that the USB communication is established, the process of the CPU 107 advances to step S804. On the other hand, if it is determined that the USB communication is not established, the process of the CPU 107 returns to step S1635. Therefore, in steps S1634 to S1636, the processing waits before the user issues an instruction or the second period set by the timer elapses until the USB communication is established.

As described above, in the third modification, when the USB plug is physically removed and the USB communication is disconnected while the projection display operation of image data stored in the connected USB device is in progress, the display apparatus 1 overwrites the image whose projection display operation is in progress by the connection request window. On the other hand, when it is determined that the USB plug is not physically removed, the image whose projection display operation is in progress is not overwritten by the connection request window until the second period elapses or the user issues an instruction. Hence, the display apparatus 1 can eliminate occurrence of situations that the image display operation is unwantedly ended in a case in which the user intends to browse images and that the image display operation is unwantedly continued in a case in which the user intends to end image browsing.

[Fourth Modification]

The fourth modification that further modifies the aforementioned third modification will be described below with reference to the flowcharts shown in FIGS. 10A and 10B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided. As shown in FIGS. 10A and 10B, in the fourth modification, step S1633 is replaced by step S1733 in the sequence of the CPU 107 exemplified in FIG. 9A (FIG. 10A), and step S1737 is added to the sequence of the CPU 107 exemplified in FIG. 9B (FIG. 10B).

The CPU 107 determines in step S1733 using the insertion detector 121 whether or not a USB plug is physically removed from the USB connector 102. If it is determined in step S1733 that the USB plug is physically removed, the process of the CPU 107 advances to step S1737. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU 107 advances to step S1634.

In step S1737, the CPU 107 sets and starts a timer which performs a count-down operation for a predetermined period (first period) which is set in advance in the ROM or the like, and is shorter than the second period set in step S1634.

As described above, in the fourth modification, when the USB plug is physically removed, and a USB communication is disconnected while the projection display operation of image data stored in the connected USB device is in progress, the display apparatus 1 overwrites the image whose projection display operation is in progress by the connection request window. The connection request window is overwritten when the first period set to be shorter than the second period elapses or when the user issues an instruction. On the other hand, when it is determined that the USB plug is not physically removed, the image whose projection display operation is in progress is not overwritten by the connection request window

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until the second period set to be longer than the first period elapses or the user issues an instruction.

Note that the description of the aforementioned embodiment is merely an example, and the present invention is not limited to this. The arrangement and operation in the aforementioned embodiment can be modified as needed. For example, the projector has been exemplified as the display apparatus in this embodiment, but a PDP, LCD, SED, CRT monitor, and the like may be used. Note that "PDP" is an abbreviation for "Plasma Display Panel". Also, "LCD" is an abbreviation for "Liquid Crystal Display". "SED" is an abbreviation for "Surface-Conduction Electron-emitter Display". Furthermore, "CRT" is an abbreviation for "Cathode Ray Tube".

This embodiment has exemplified the arrangement using USB, but the present invention is not particularly limited to this. For example, an SDIO (Secure Digital Input/Output) interface and other interfaces may be used. Furthermore, as an external storage device using a USB mass storage, an SD (Secure Digital) card memory, CF card, and the like may be used.

In the second, third, and fourth modifications, the insertion detector 121, which is a mechanism for detecting a physical contact of the connector, is used as means for detecting a physical connection of the USB plug, but the detection mechanism is not particularly limited. For example, as another means for detecting a physical connection of the USB plug, a current amount that flows through the VBUS line may be measured, and if the measured current amount exceeds a predetermined value, it may be determined that the USB plug is physically connected.

Other Embodiments

The aforementioned embodiments can be implemented in a software manner by a computer (or a CPU, MPU, etc.) of a system or apparatus. Therefore, a computer program itself supplied to the computer to implement the aforementioned embodiments using the computer implements the present invention. That is, the computer program itself required to implement the functions of the aforementioned embodiments is one invention of the present invention.

Note that the form of the computer program required to implement the aforementioned embodiments is not particularly limited as long as that program is computer-readable. For example, the program may adopt the forms of an object code, a program to be executed by an interpreter, script data to be supplied to an OS, and the like, but the present invention is not limited to them. The computer program required to implement the aforementioned embodiments is supplied to the computer via a storage medium or wired/wireless communications. As the storage medium for supplying the program, for example, magnetic storage media such as a flexible disk, hard disk, and magnetic tape, optical/magneto-optical storage media such as an MO, CD, and DVD, a nonvolatile semiconductor memory, and so forth may be used.

As a computer program supply method using the wired/wireless communications, a method using a server on a computer network is available. In this case, a server stores a data file (program file) that can be a computer program which forms the present invention. The program file may be either an executable format file or source codes. Then, the program file is supplied by downloading to a client computer that has accessed the server. In this case, the program file may be segmented into a plurality of segment files, which may be allocated on different servers. That is, the server which pro-

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vides the program file required to implement the aforementioned embodiments to the client computer is also one invention of the present invention.

Also, a storage medium, which stores the encrypted program required to implement the aforementioned embodiments, may be delivered, and key information required to decrypt the encrypted program may be supplied to the user who meets a predetermined condition, so as to allow that user to install the program on a computer of the user. The key information can be supplied to the user by making him or her download it from a homepage via, for example, the Internet. The computer program required to implement the aforementioned embodiments may use the functions of an OS which already runs on the computer. Furthermore, some functions of the computer program required to implement the aforementioned embodiments may be configured by firmware which runs on an expansion board or the like attached to the computer, or may be executed by a CPU equipped on the expansion board or the like.

The present invention is not limited to the above embodiments and various changes and modifications can be made within the spirit and scope of the present invention. Therefore, to apprise the public of the scope of the present invention, the following claims are appended.

This application claims the benefit of Japanese Patent Application No. 2008-141678, filed May 29, 2008, which is hereby incorporated by reference herein in its entirety.

The invention claimed is:

1. A display apparatus comprising:

a communication unit configured to communicate with an external device;

a display unit configured to display an image received from the external device;

a storing unit configured to store information for controlling whether or not to continue the display of the image being displayed by the display unit when the communication is disconnected, wherein said information includes at least one of information indicating types of external devices for which display of an image should be continued and information indicating types of external devices for which display of an image should not be continued;

a determination unit configured to determine whether or not to continue the display of the image received from the external device by comparing the type of the external device involving the communication by the communication unit with said information stored in the storing unit; and

a control unit configured to control whether or not to continue the display of the image being displayed by the display unit when the communication is disconnected, in accordance with the determination result by the determination unit.

2. The display apparatus according to claim 1, wherein said information stored in the storing unit includes information indicating types of external devices which logically disconnect the communication with the communication unit.

3. The display apparatus according to claim 2, wherein the control unit controls to continue the display of the image being displayed by the display unit when the communication is disconnected, if the type of the external device is one of the types of external devices which logically disconnect the communication with the communication unit.

4. The display apparatus according to claim 1, wherein the control unit controls to end the display of the image being

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displayed by the display unit when the communication is disconnected, if the type of the external device is in a USB Mass Storage Class.

5. The display apparatus according to claim 1, wherein the control unit controls to continue the display of the image being displayed by the display unit when the communication is disconnected, if the type of the external device is in a USB Imaging Class.

6. A display apparatus comprising:

a communication unit configured to communicate with an external device;

a display unit configured to display an image received from the external device;

a determination unit configured to determine whether or not to continue the display of the image received from the external device by detecting whether the communication is physically disconnected or whether the communication is logically disconnected when the communication with the external device is disconnected; and

a control unit configured to control whether or not to continue the display of the image being displayed by the display unit when the communication is disconnected, in accordance with the determination result by the determination unit.

7. The display apparatus according to claim 6, wherein, when the communication with the external device is physically disconnected, the control unit controls to end the display of the image being displayed by the display unit after a predetermined first period elapses.

8. The display apparatus according to claim 7, wherein, when the communication with the external device is logically disconnected, the control unit controls to end the display of the image being displayed by the display unit after a predetermined second period, which is longer than the first period, elapses.

9. The display apparatus according to claim 6, wherein the communication unit is connected to the external device via a physical communication interface.

10. A control method of a display apparatus which comprises:

a communication unit configured to communicate with an external device;

a display unit configured to display an image received from the external device; and

a storing unit configured to store information for controlling whether or not to continue the display of the image being displayed by the display unit when the communication is disconnected, wherein said information includes at least one of information indicating types of external devices for which display of an image should be continued and information indicating types of external devices for which display of an image should not be continued.

the method comprising:

a determination step of determining whether or not to continue the display of the image received from the external device by comparing the type of the external device involving the communication by the communication unit with said information stored in the storing unit; and

a control step of controlling whether or not to continue the display of the image being displayed by the display unit when the communication is disconnected, in accordance with the determination result in the determination step.

11. A control method of a display apparatus which comprises:

a communication unit configured to communicate with an external device; and

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a display unit configured to display an image received from the external device.

the method comprising:

a determination step of determining whether or not to continue the display of the image received from the external device by detecting whether the communication is physically disconnected or whether the communication

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is logically disconnected when the communication with the external device is disconnected; and

a control step of controlling whether or not to continue the display of the image being displayed by the display unit when the communication is disconnected, in accordance with the determination result in the determination step.

* * * * *



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(12) **United States Patent**
Kotani

(10) **Patent No.:** **US 8,713,206 B2**
(45) **Date of Patent:** **Apr. 29, 2014**

(54) **DISPLAY APPARATUS, CONTROL METHOD THEREOF, AND PROGRAM**

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(72) Inventor: **Junji Kotani**, Inagi (JP)

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(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(21) Appl. No.: **13/707,652**

(22) Filed: **Dec. 7, 2012**

(Continued)

(65) **Prior Publication Data**

US 2013/0162659 A1 Jun. 27, 2013

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Related U.S. Application Data

(60) Continuation of application No. 13/281,543, filed on Oct. 26, 2011, now Pat. No. 8,346,986, which is a division of application No. 12/545,270, filed on Aug. 21, 2009, now Pat. No. 8,078,767, which is a continuation of application No. PCT/JP2009/055831, filed on Mar. 24, 2009.

Primary Examiner — Ilwoo Park

(74) *Attorney, Agent, or Firm* — Fitzpatrick, Cella, Harper & Scinto

(30) **Foreign Application Priority Data**

May 29, 2008 (JP) 2008-141678

(51) **Int. Cl.**
G06F 13/10 (2006.01)

(52) **U.S. Cl.**
USPC 710/8; 710/14; 710/15; 710/16

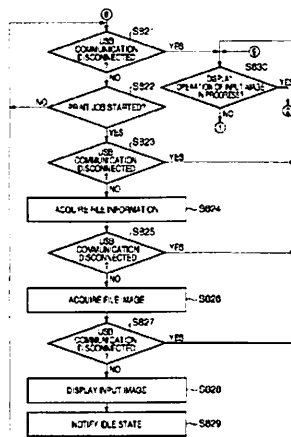
(58) **Field of Classification Search**

None

See application file for complete search history.

(57) **ABSTRACT**

A display apparatus includes a USB connector used to connect an external device so as to be able to communicate with that device. The display apparatus also includes a CPU which controls to make a display based on data received from the external device with which a communication connection is established via the USB connector. The CPU acquires class information indicating a class of the external device, the communication connection of which is established. When the communication connection with the external device is disconnected, if the acquired class information indicates a predetermined class, the CPU controls to continue the display based on the received data, and if the class information does not indicate the predetermined class, the CPU controls to end the display.



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14 Claims, 28 Drawing Sheets

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FIG. 1A

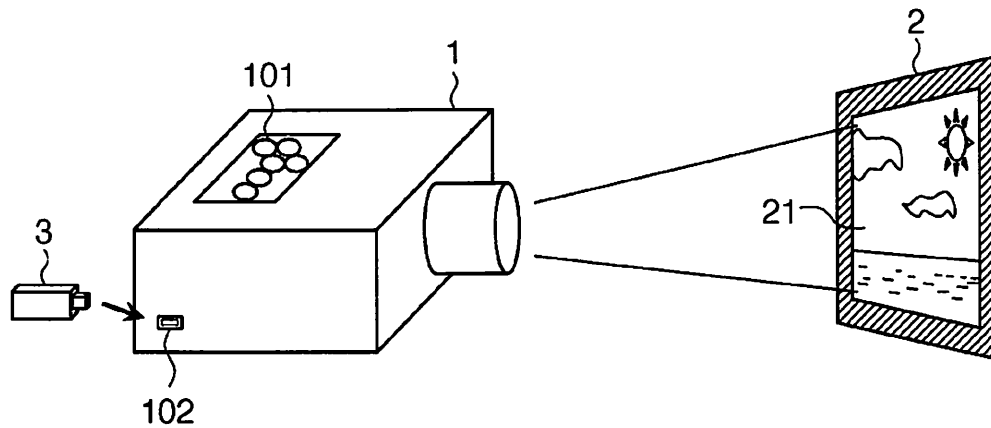


FIG. 1B

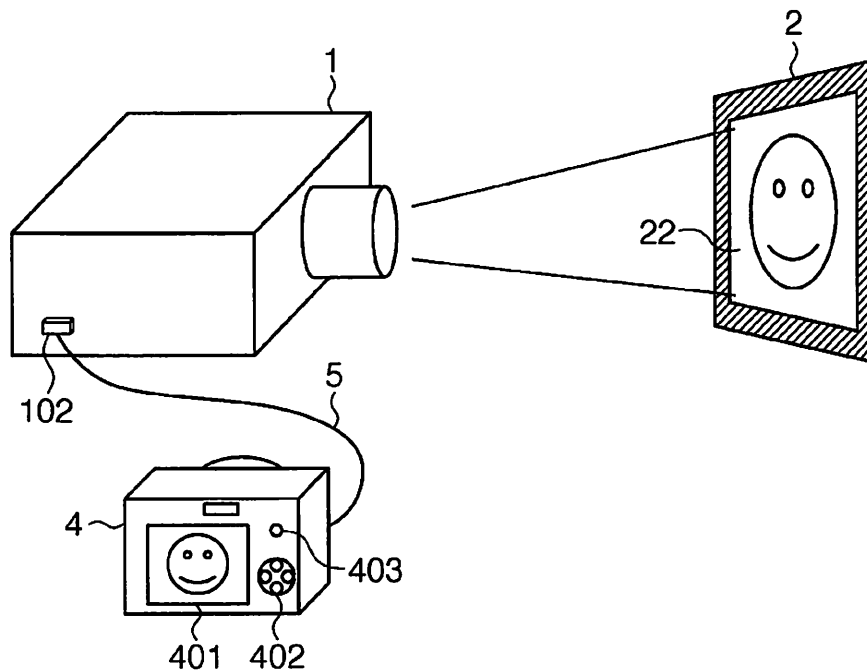
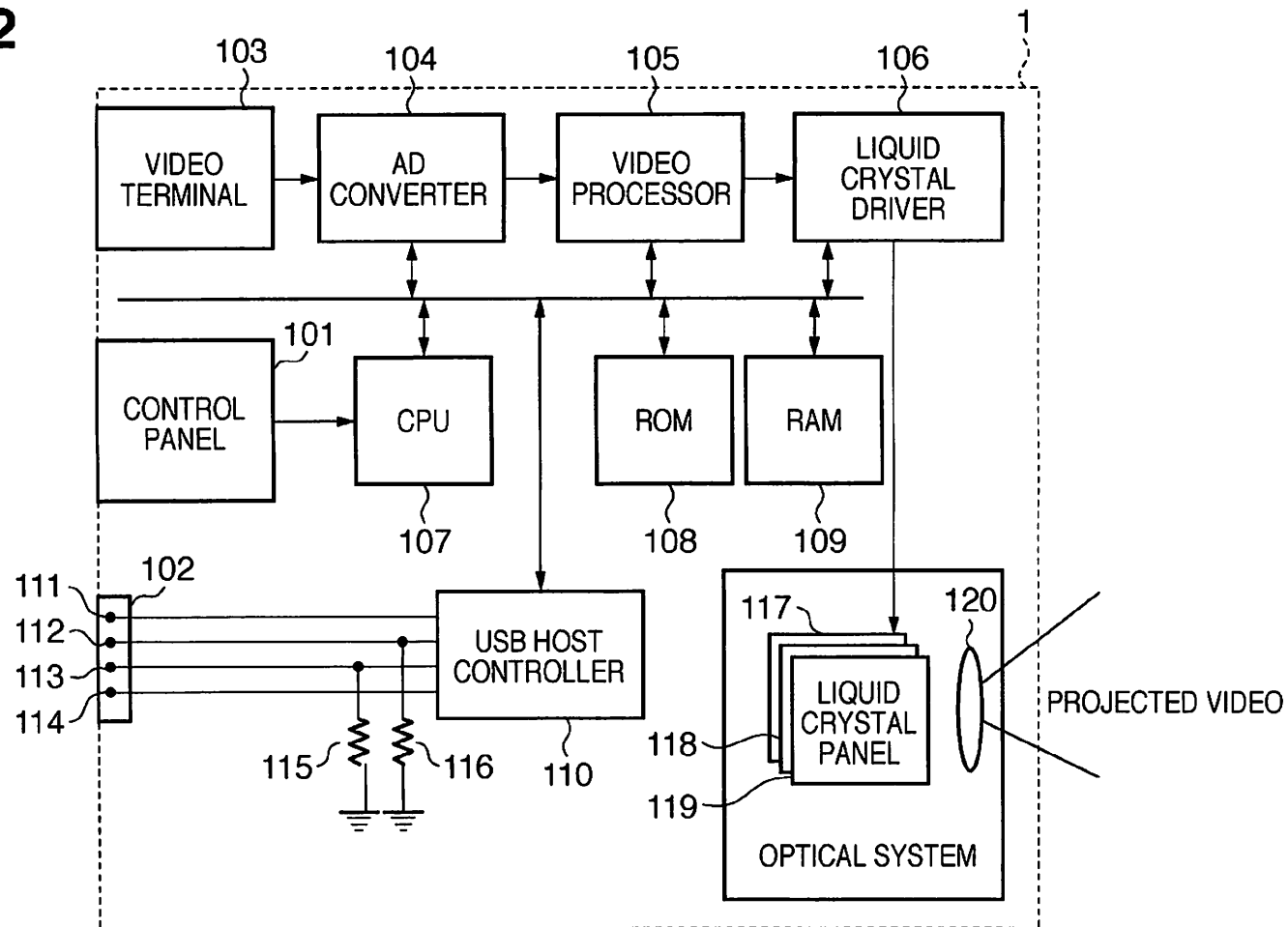


FIG. 2

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FIG. 3

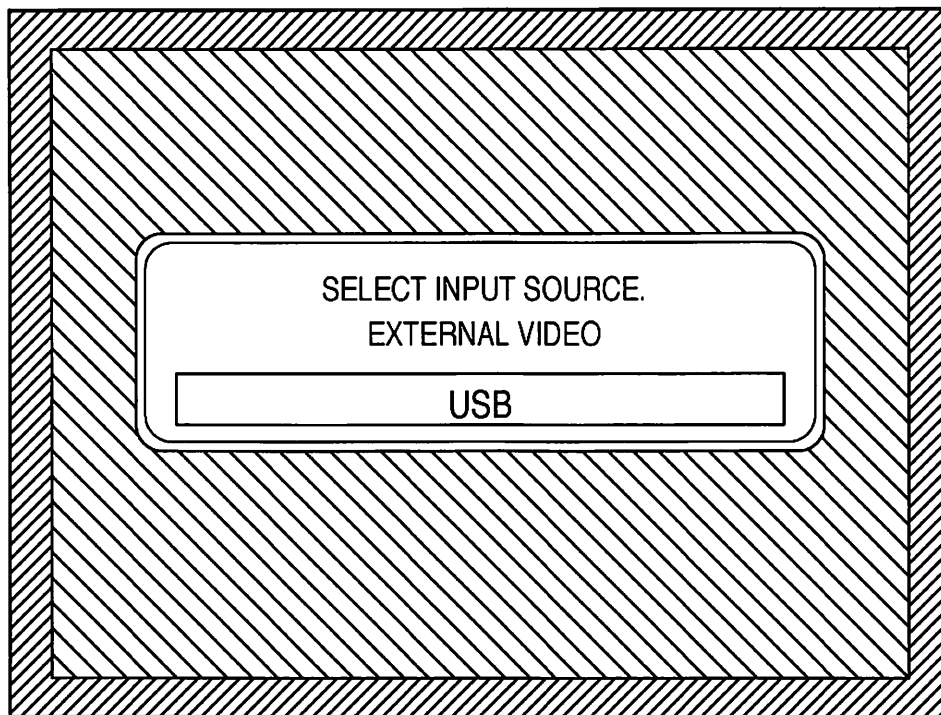
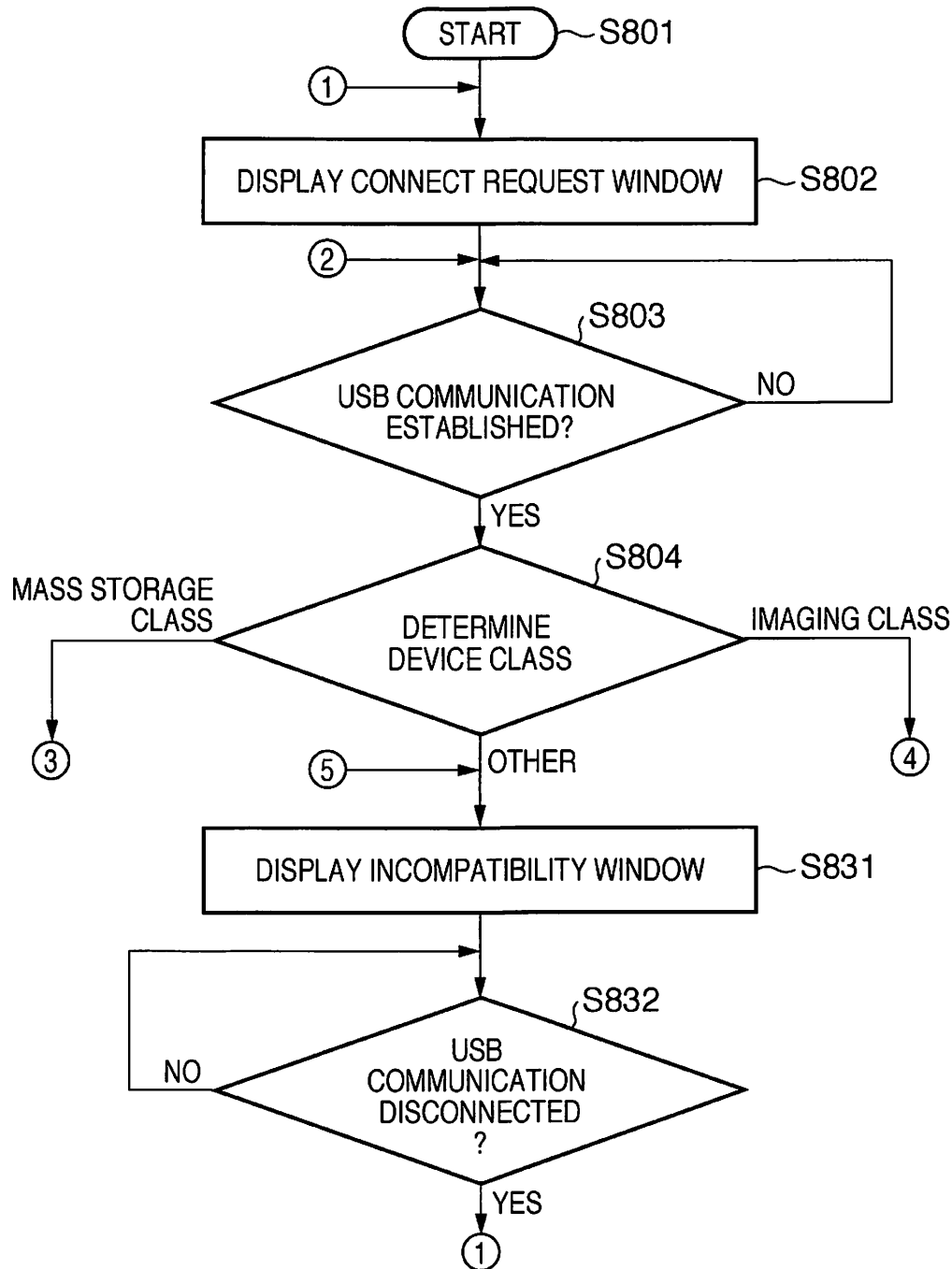


FIG. 4A

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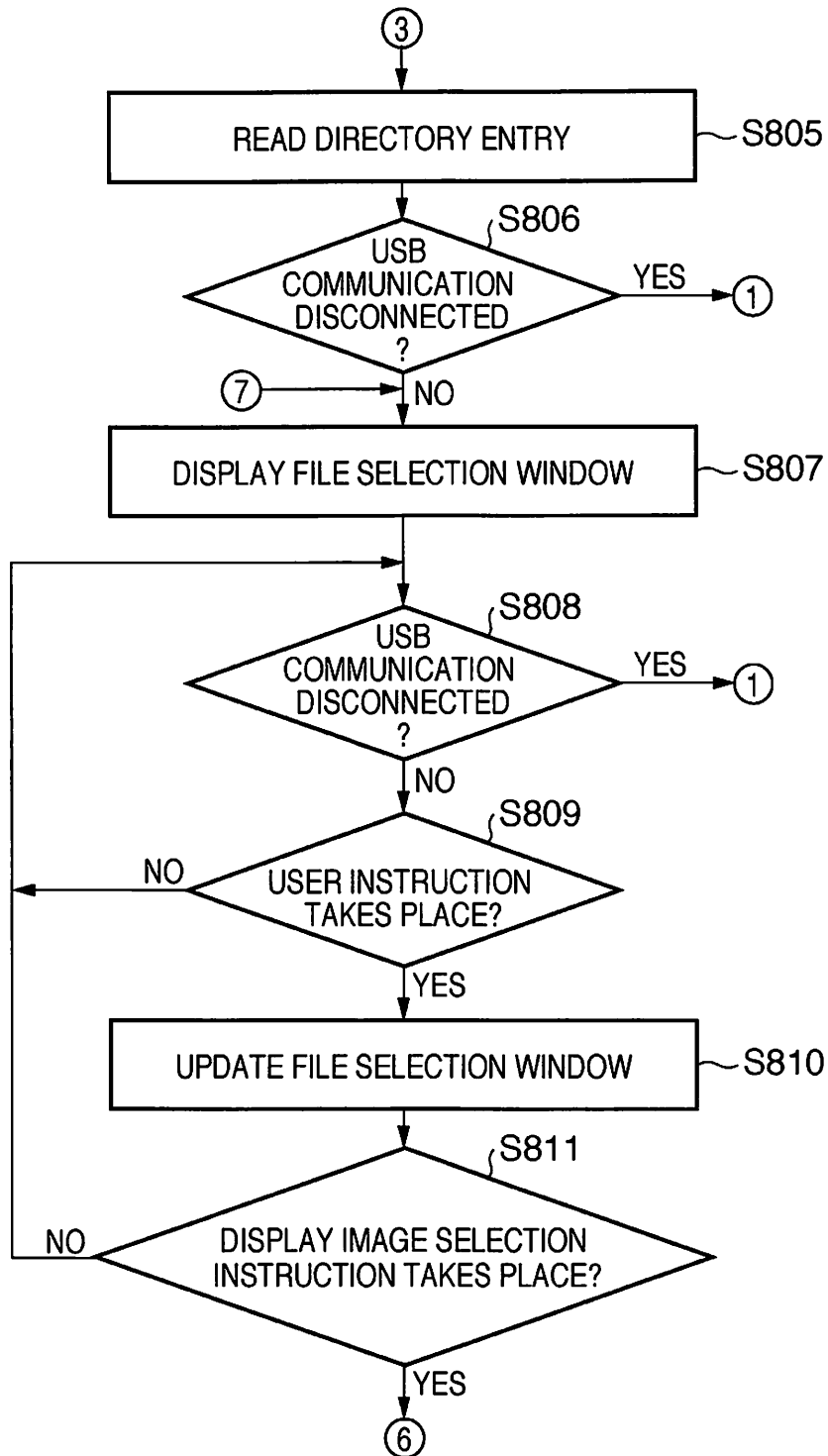
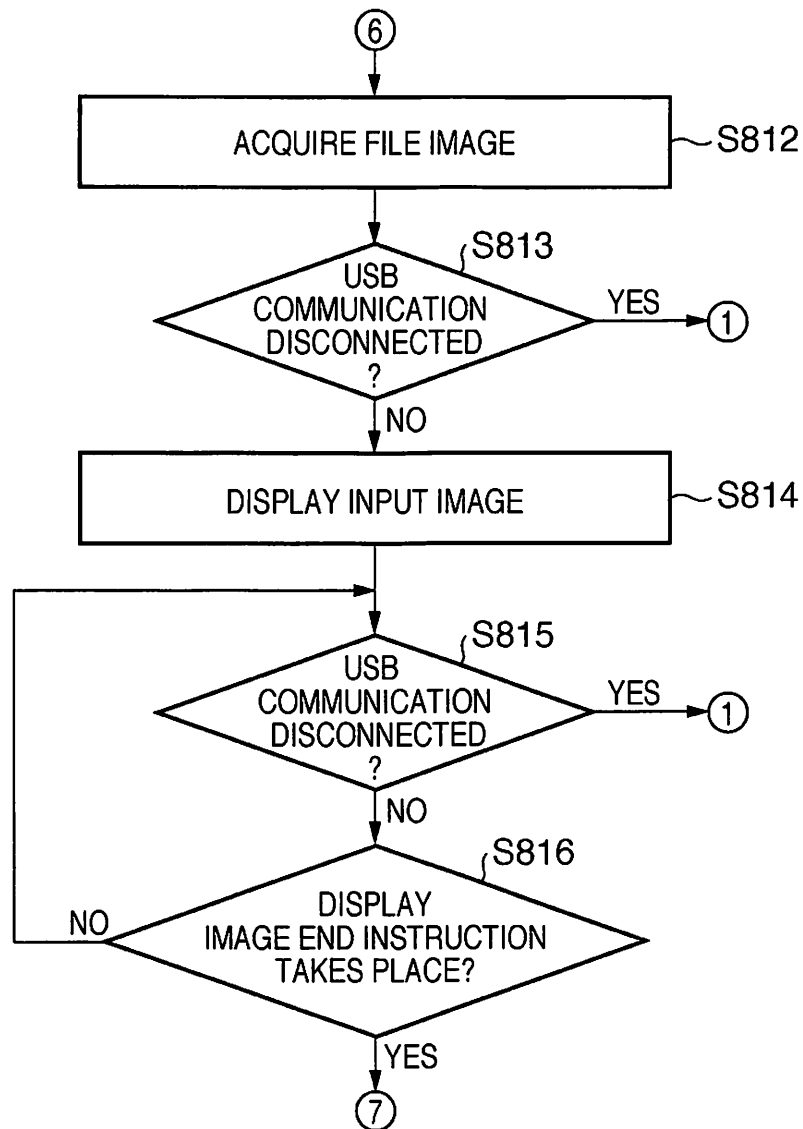
FIG. 4B-1

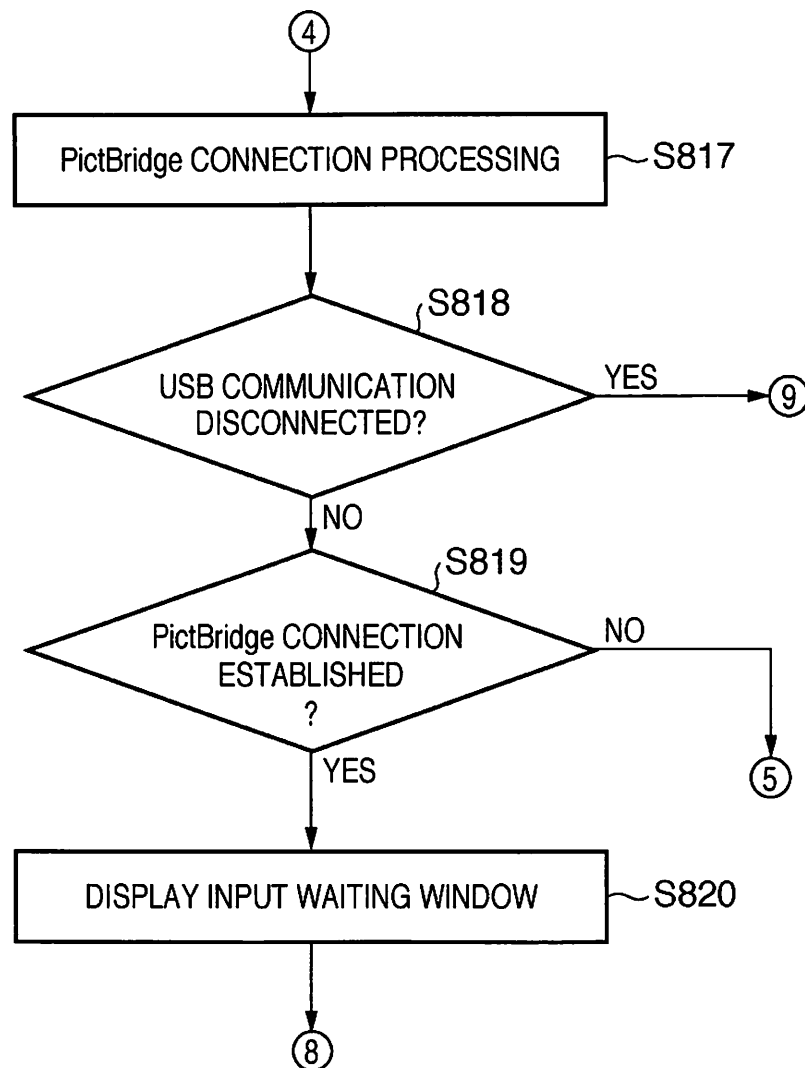
FIG. 4B-2

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FIG. 4C-1

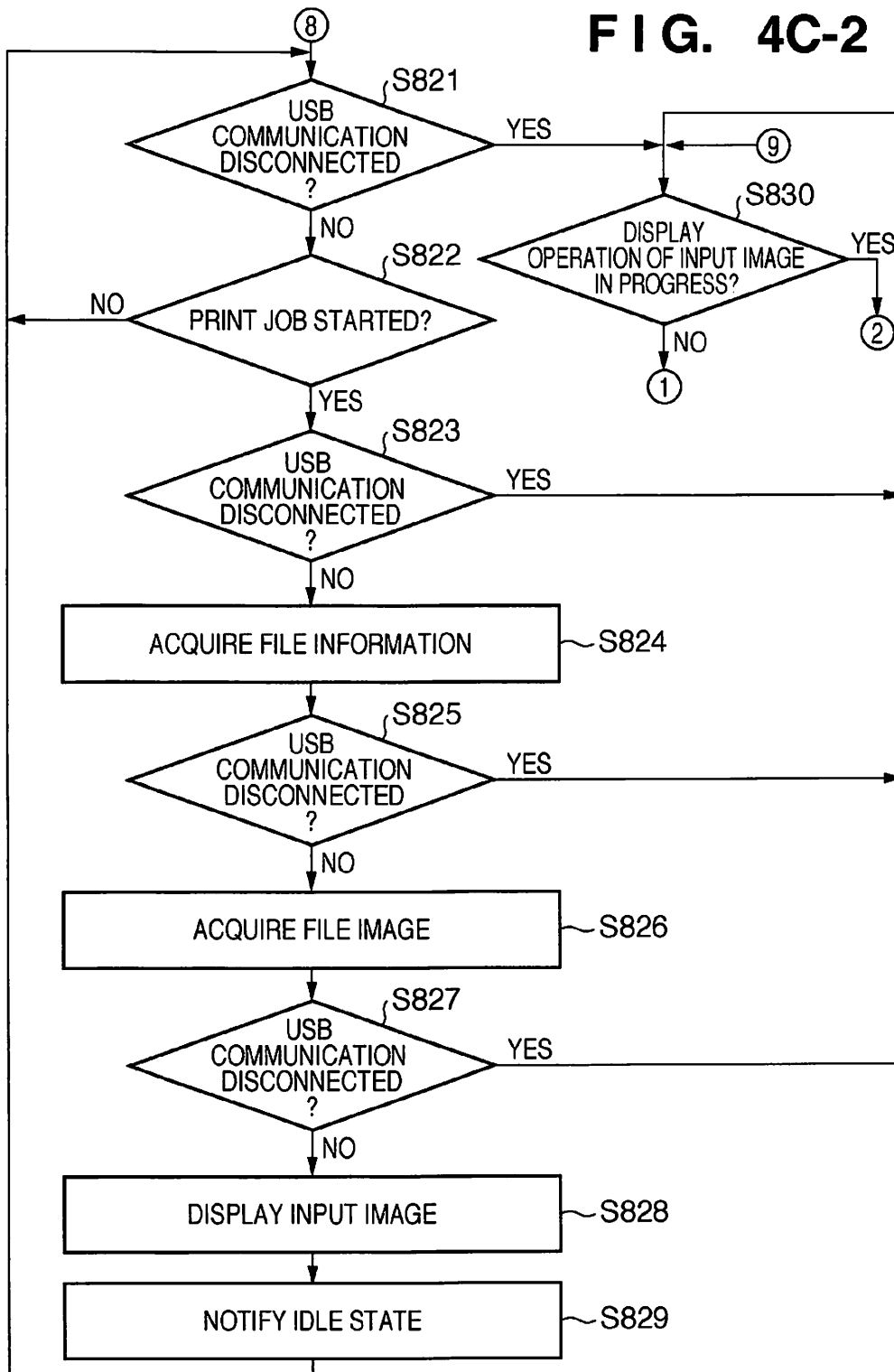
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FIG. 4C-2



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FIG. 5A

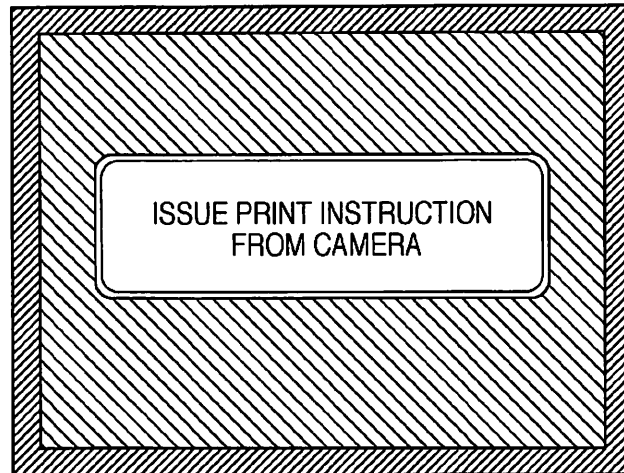


FIG. 5B

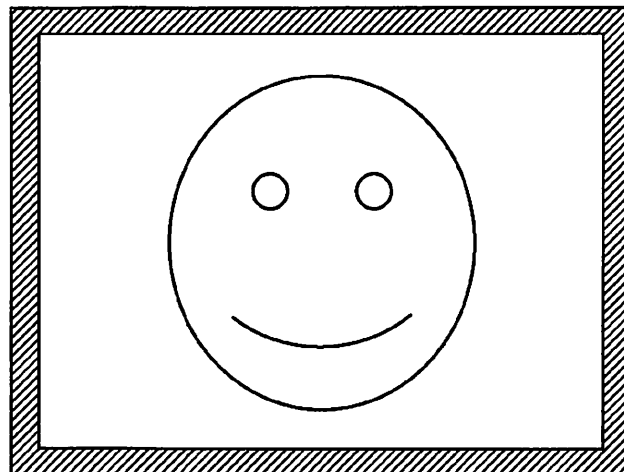
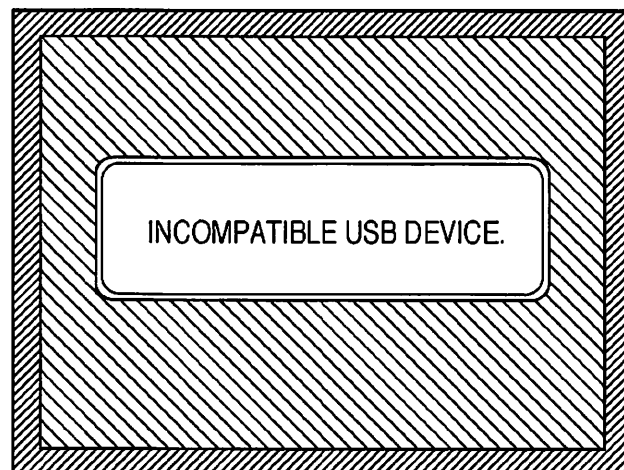


FIG. 5C

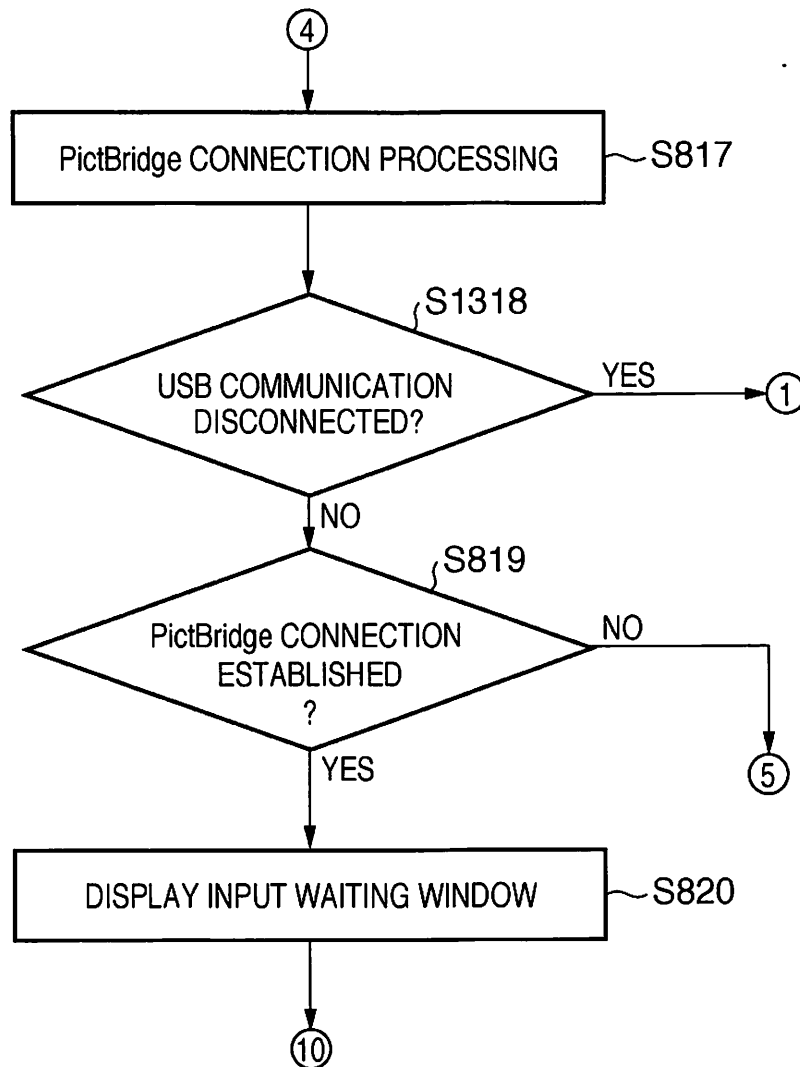


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FIG. 6A

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FIG. 6B

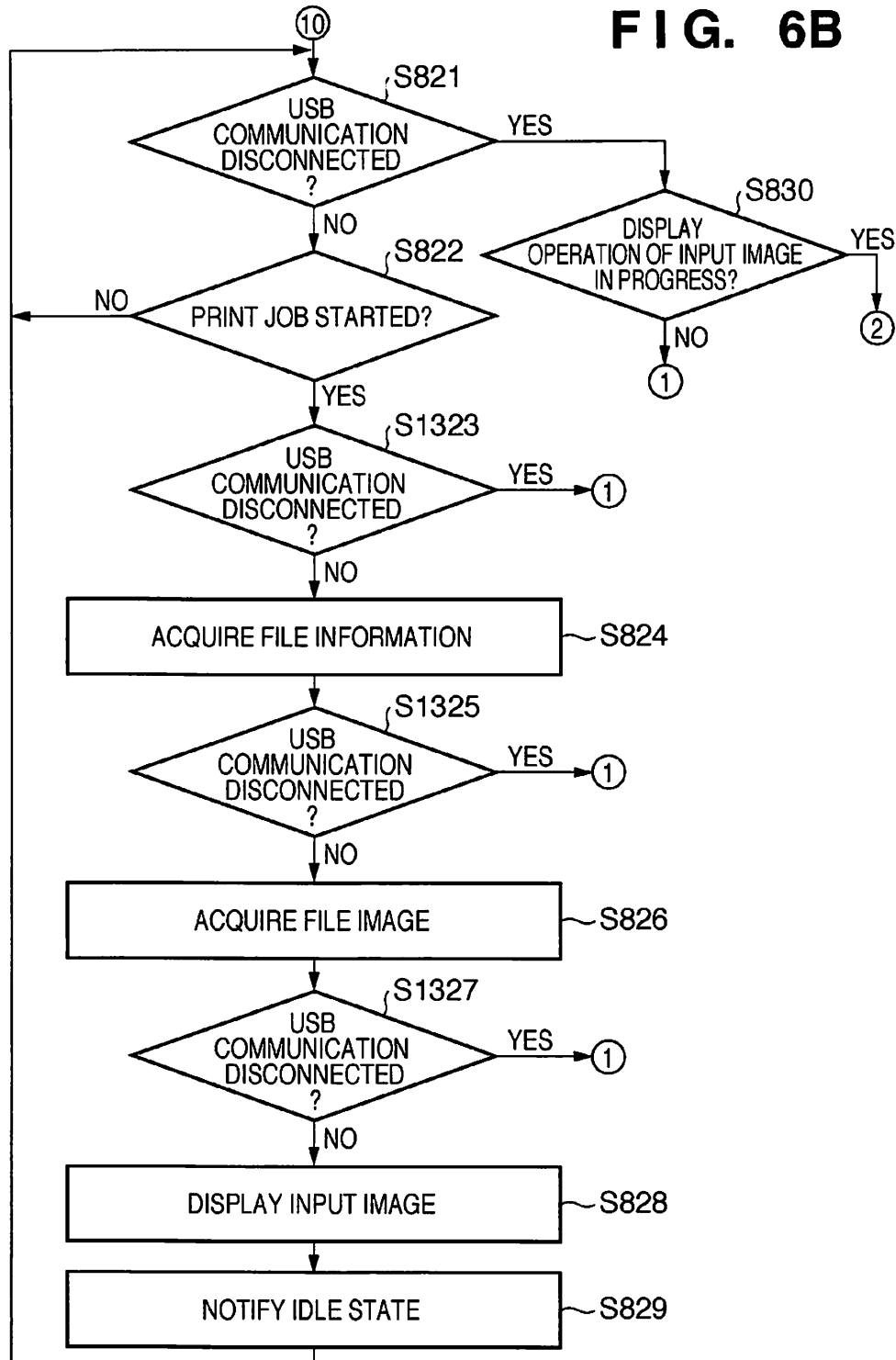


FIG. 7

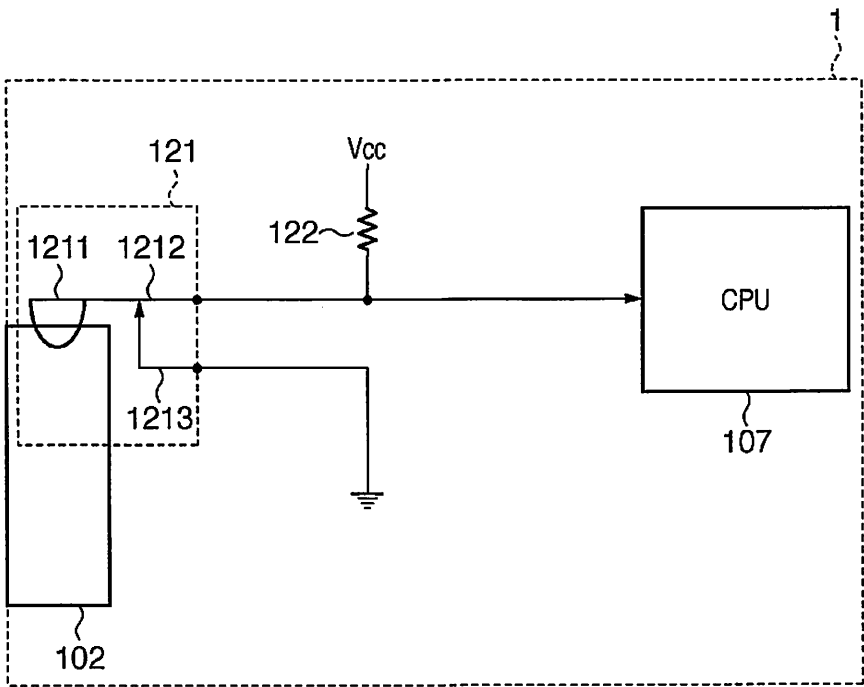
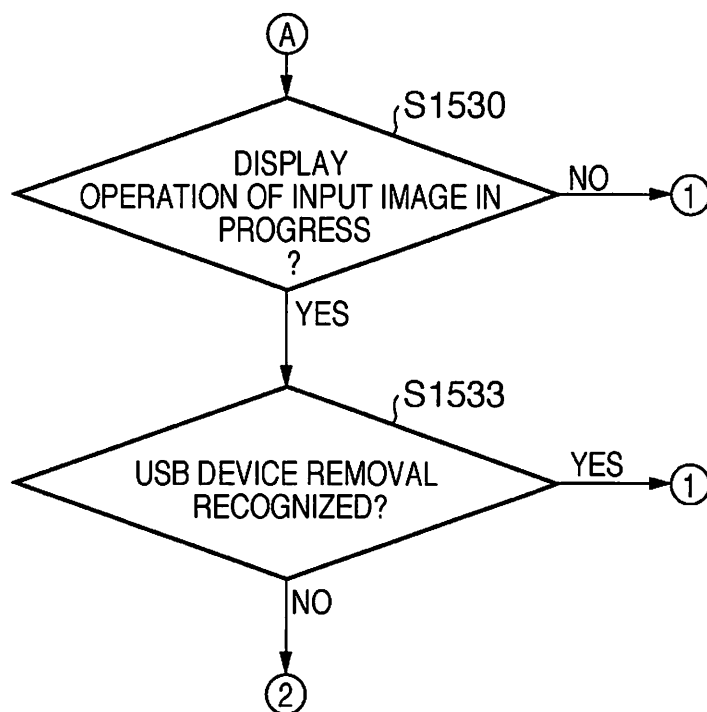


FIG. 8A



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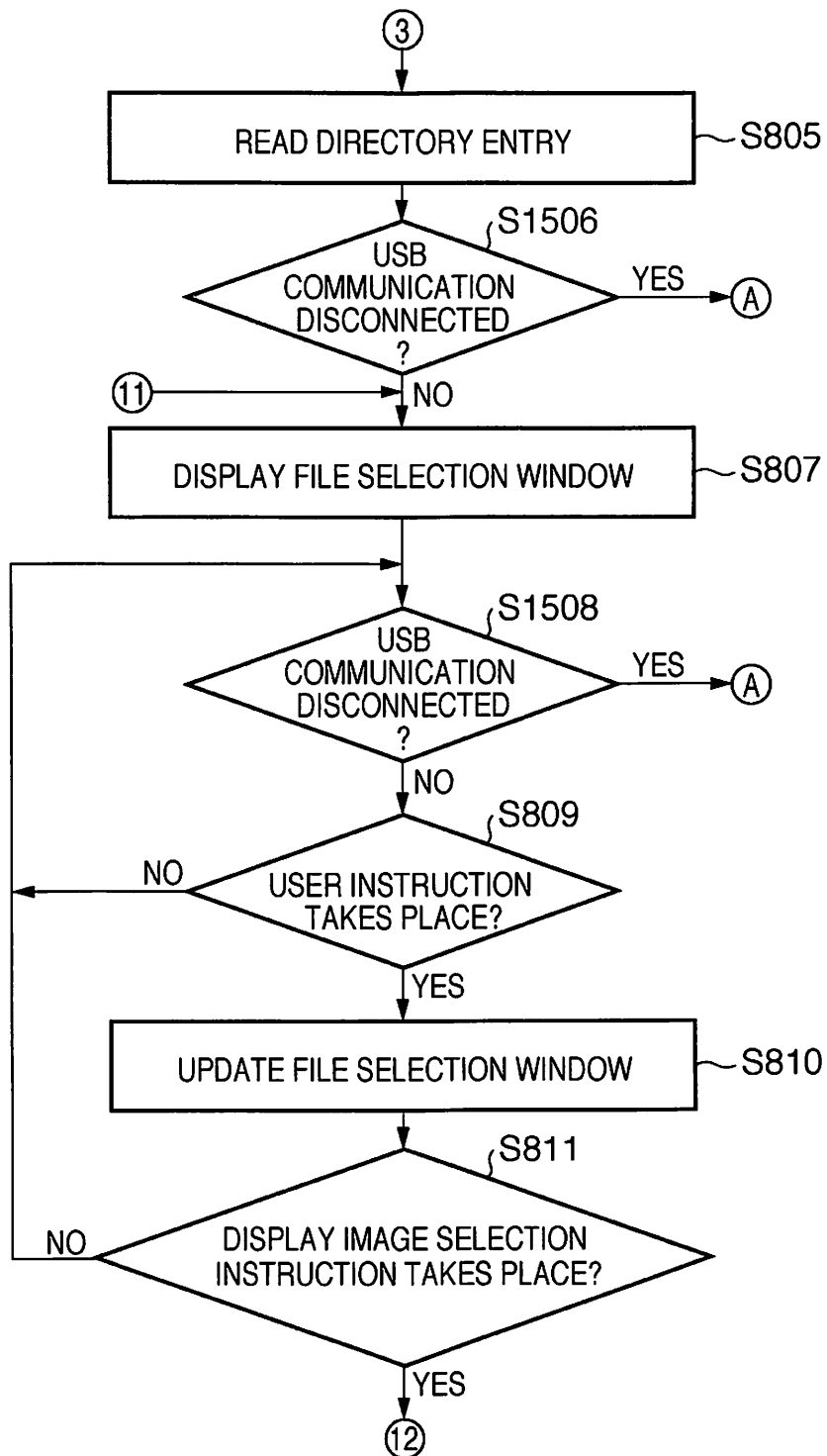
FIG. 8B-1

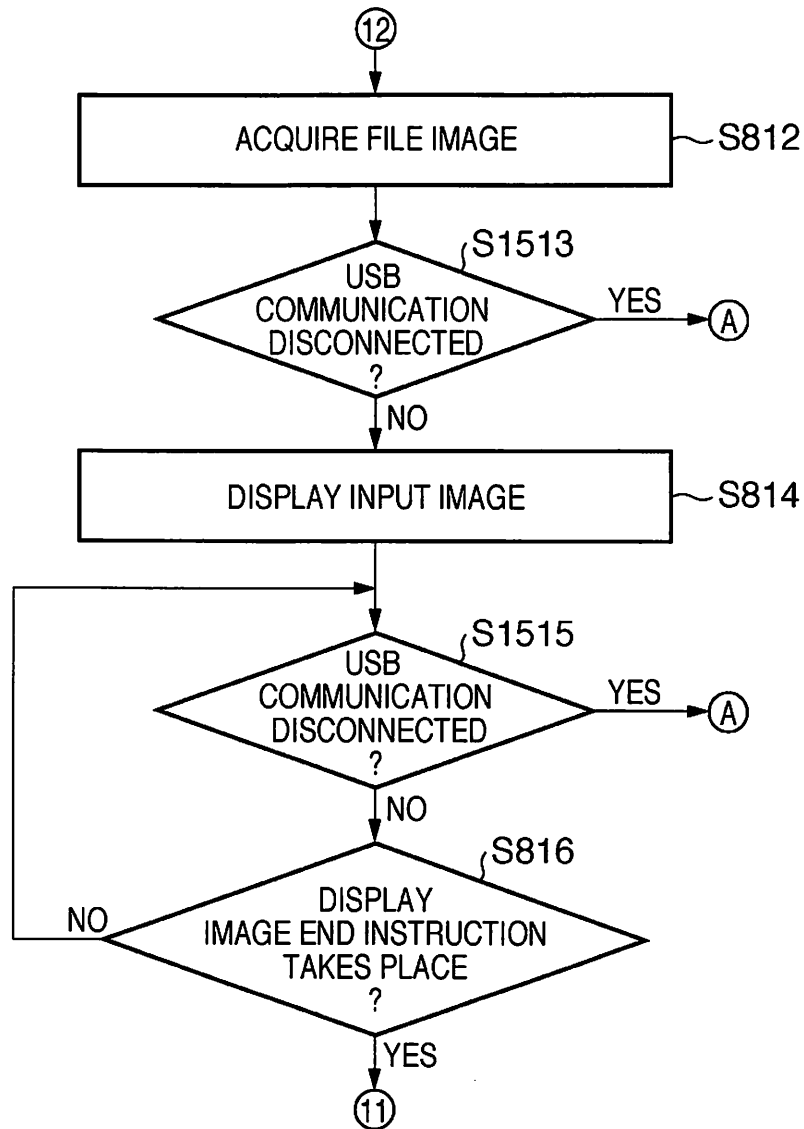
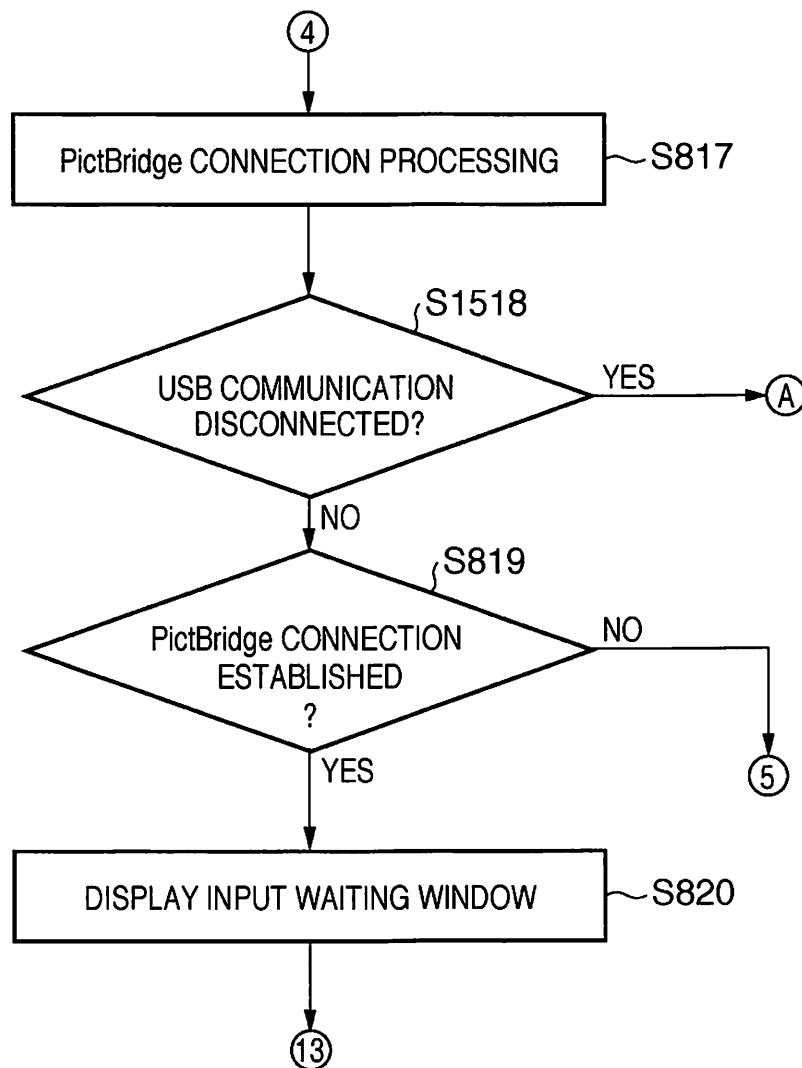
FIG. 8B-2

FIG. 8C-1

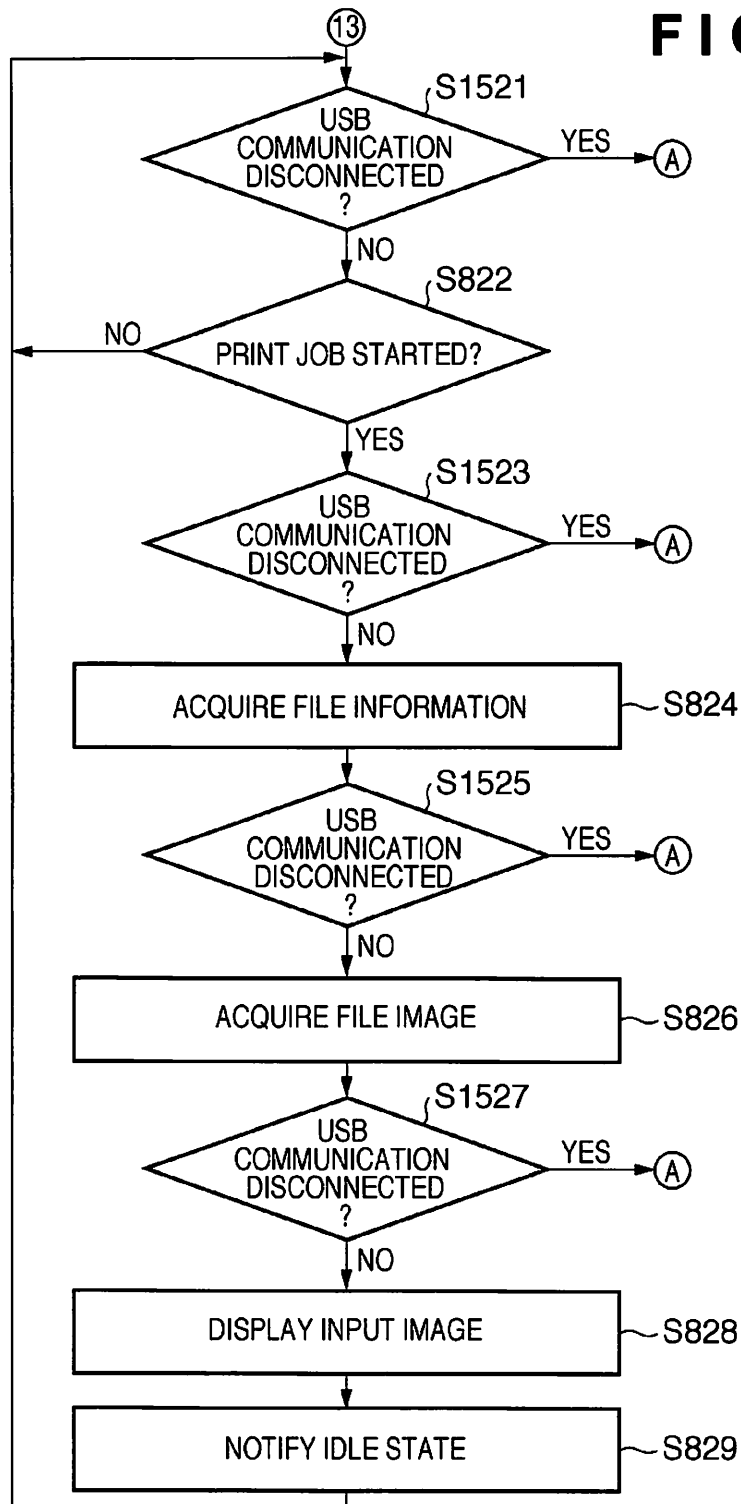
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FIG. 8C-2

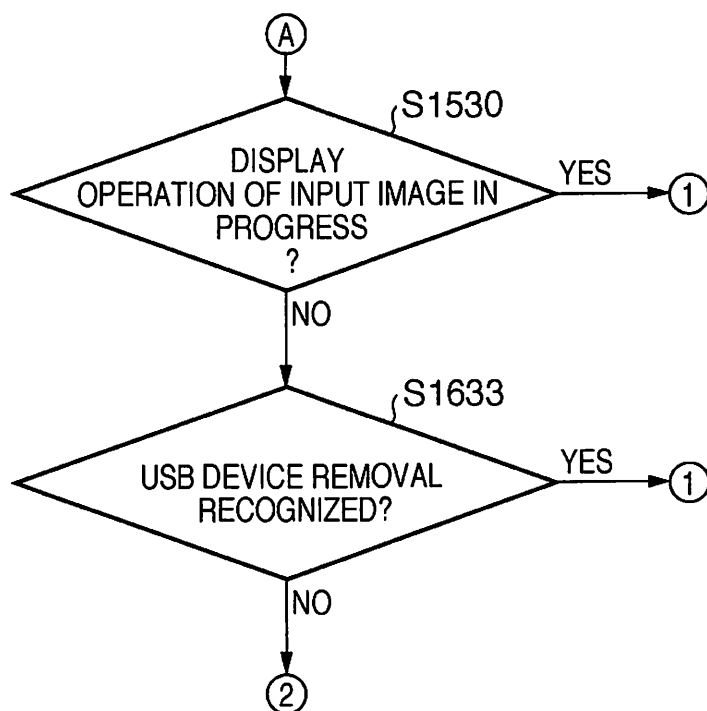


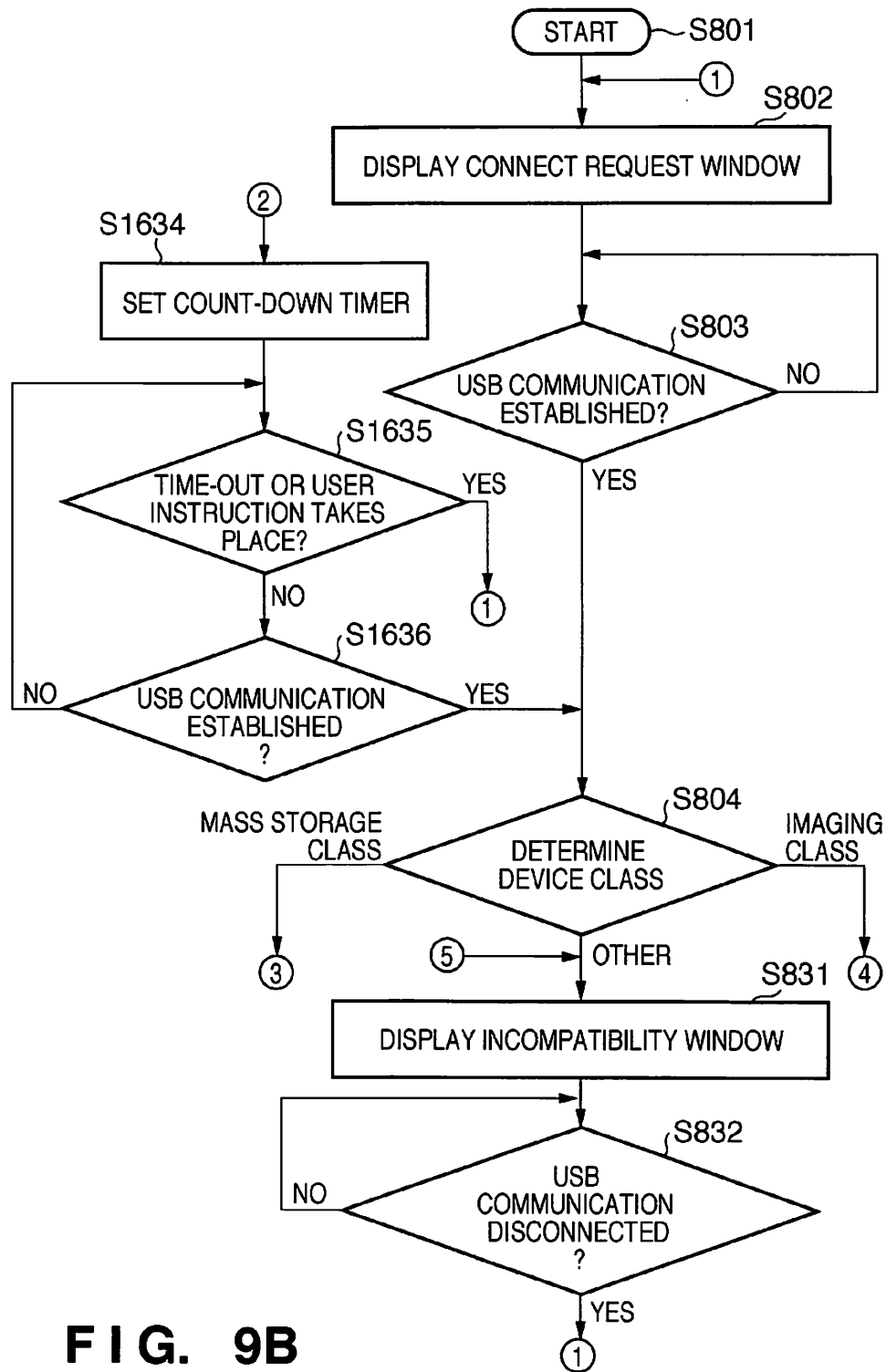
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FIG. 9A

**FIG. 9B**

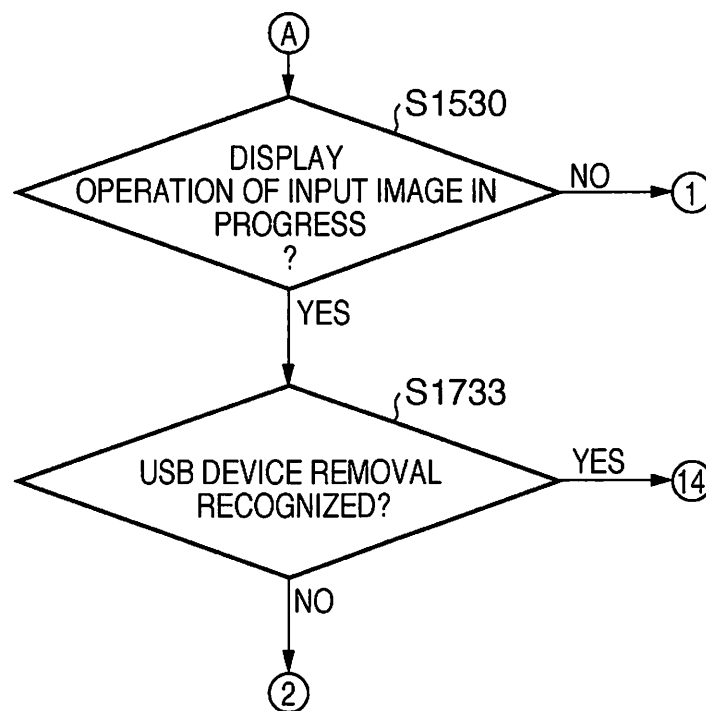
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FIG. 10A

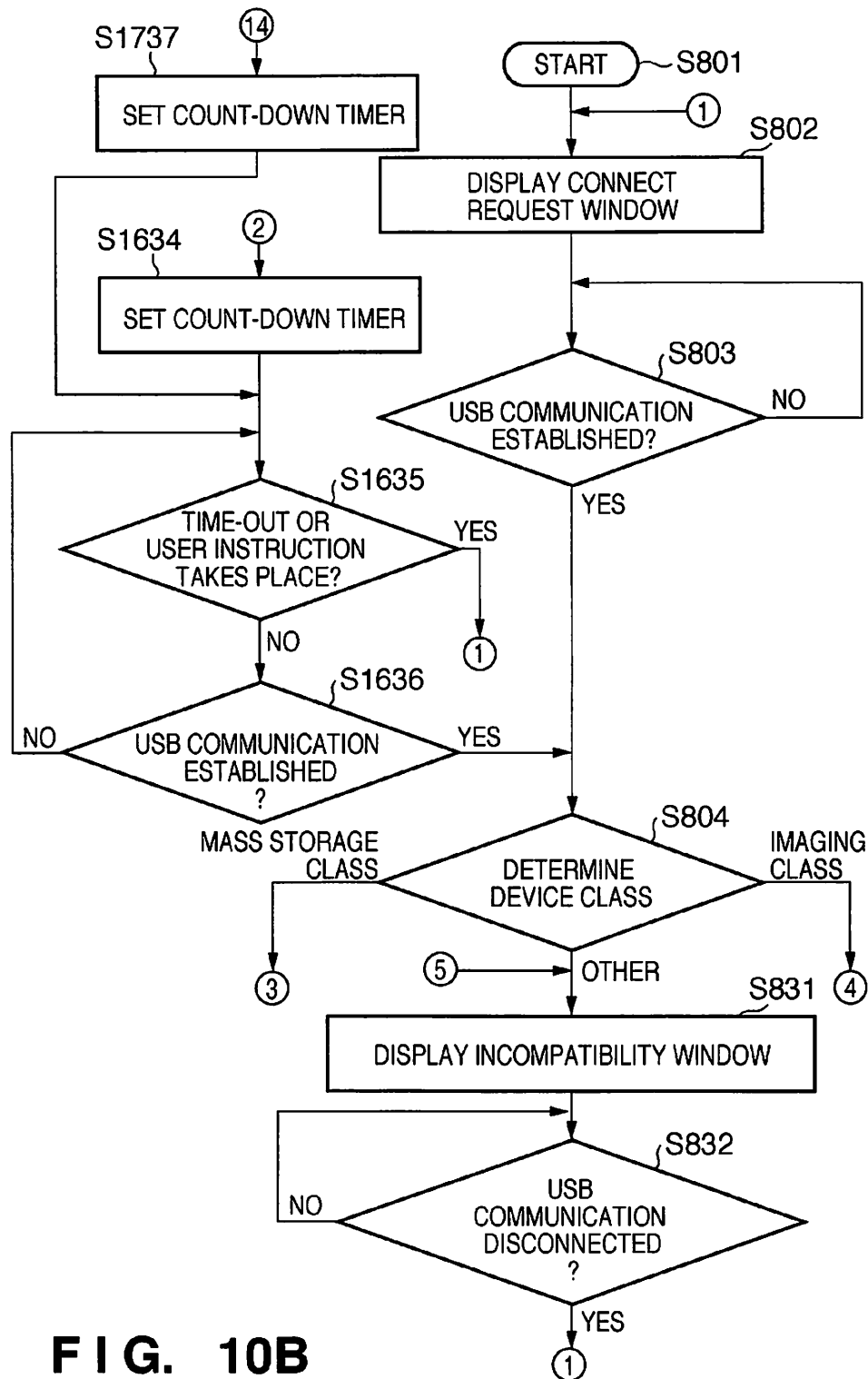


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FIG. 11A

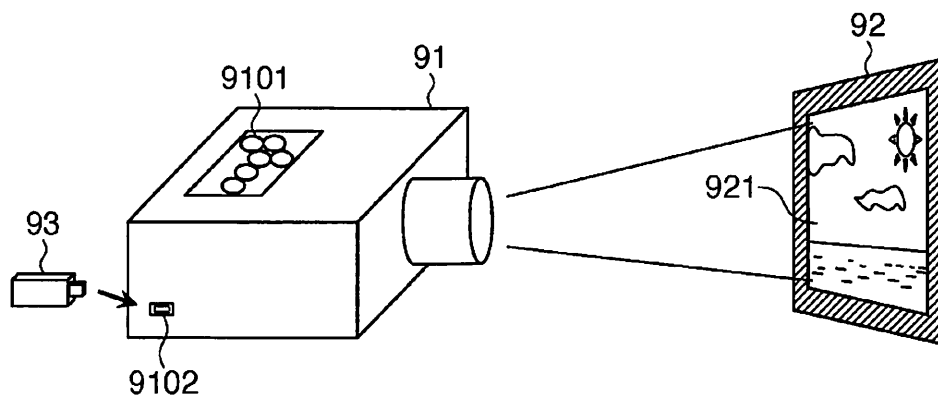
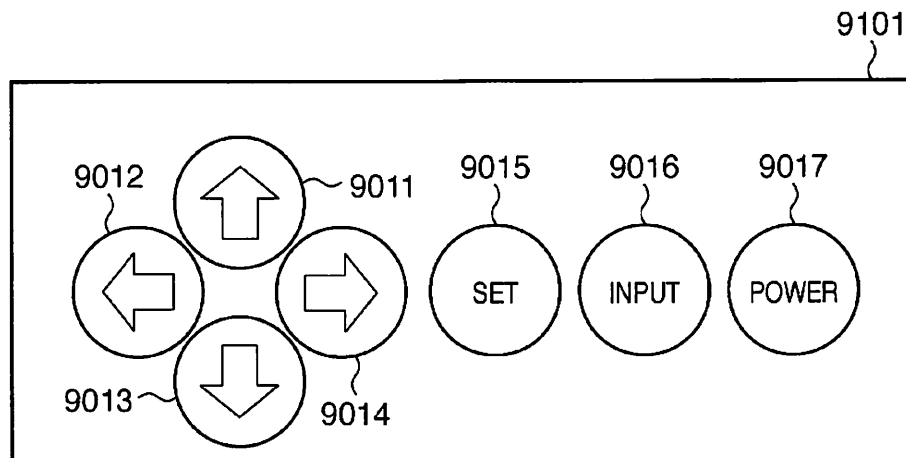


FIG. 11B



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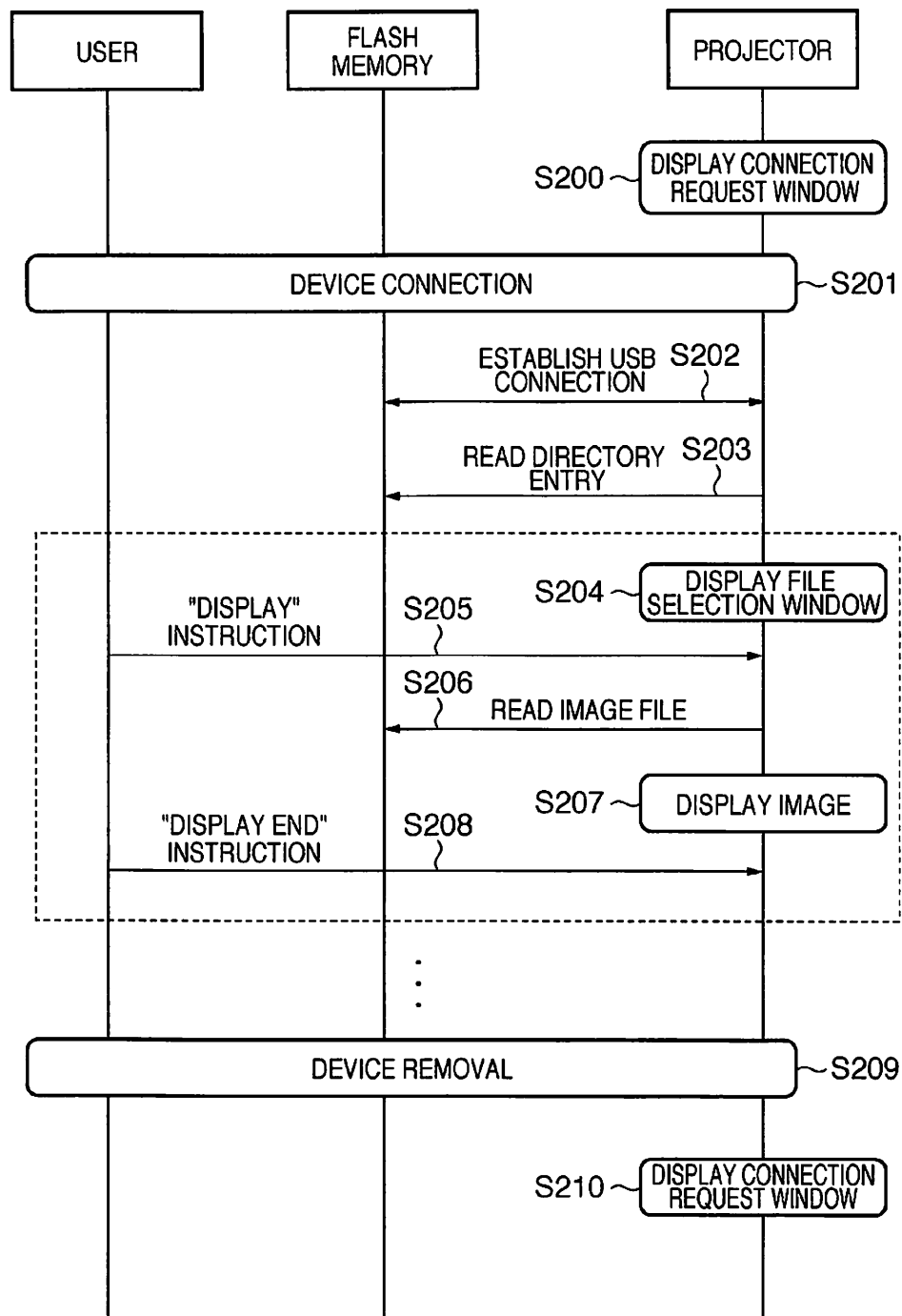
FIG. 12

FIG. 13A

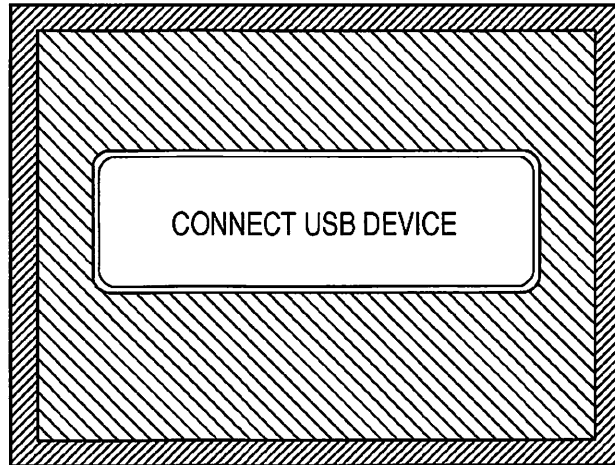


FIG. 13B

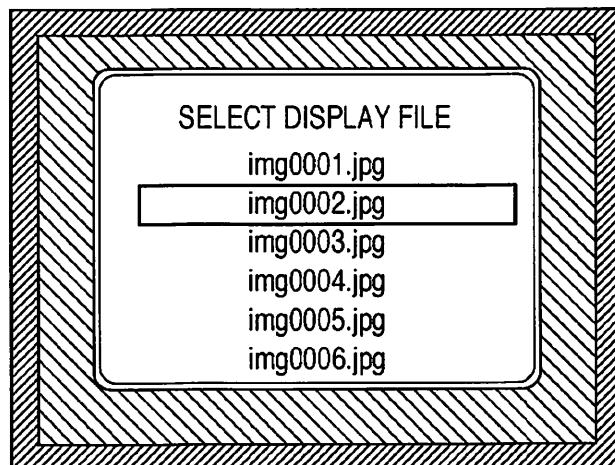
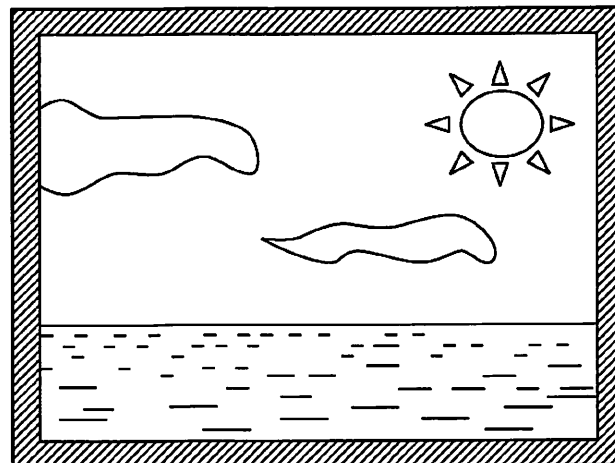


FIG. 13C



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FIG. 14A

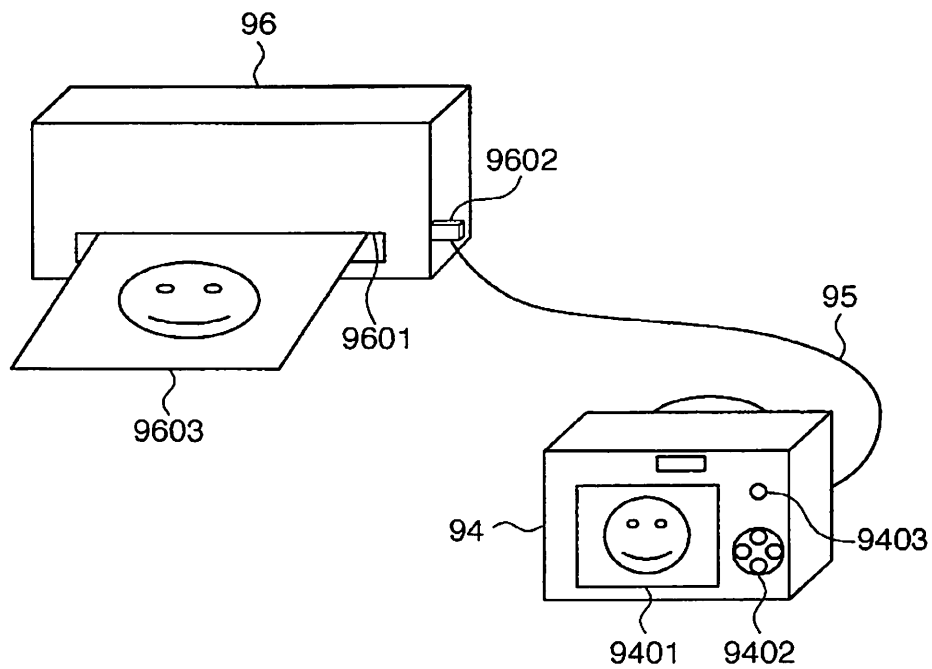
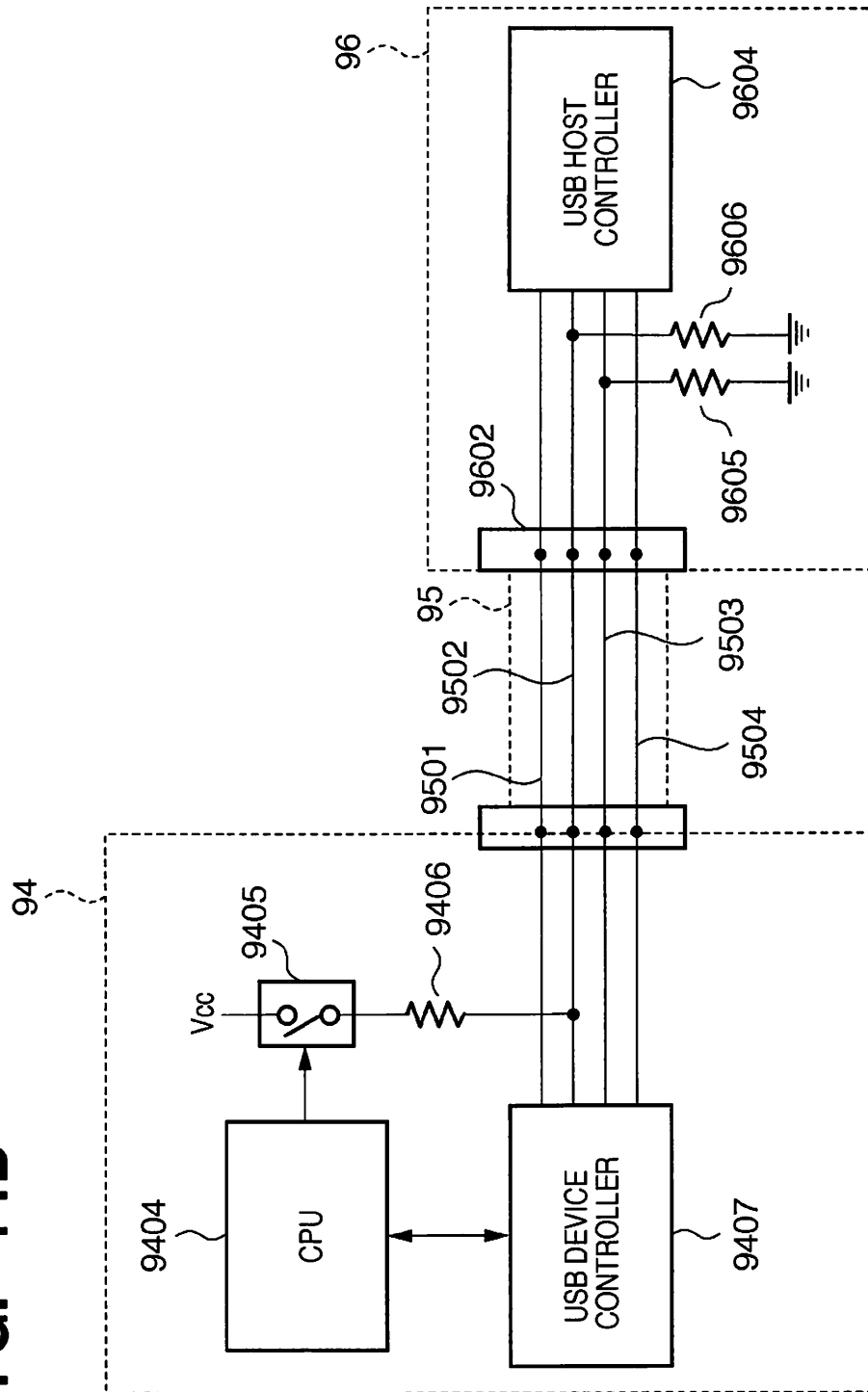


FIG. 14B



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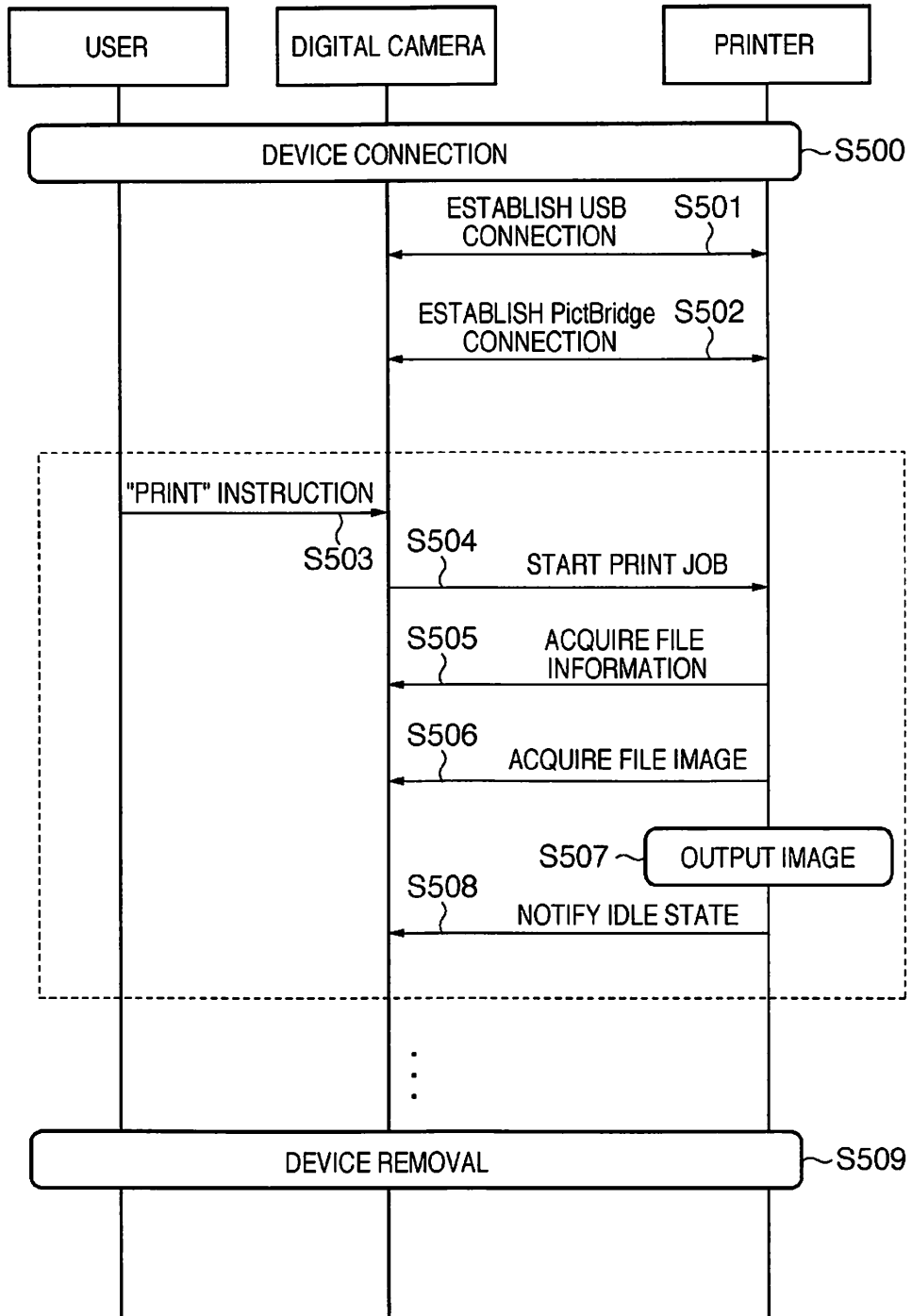
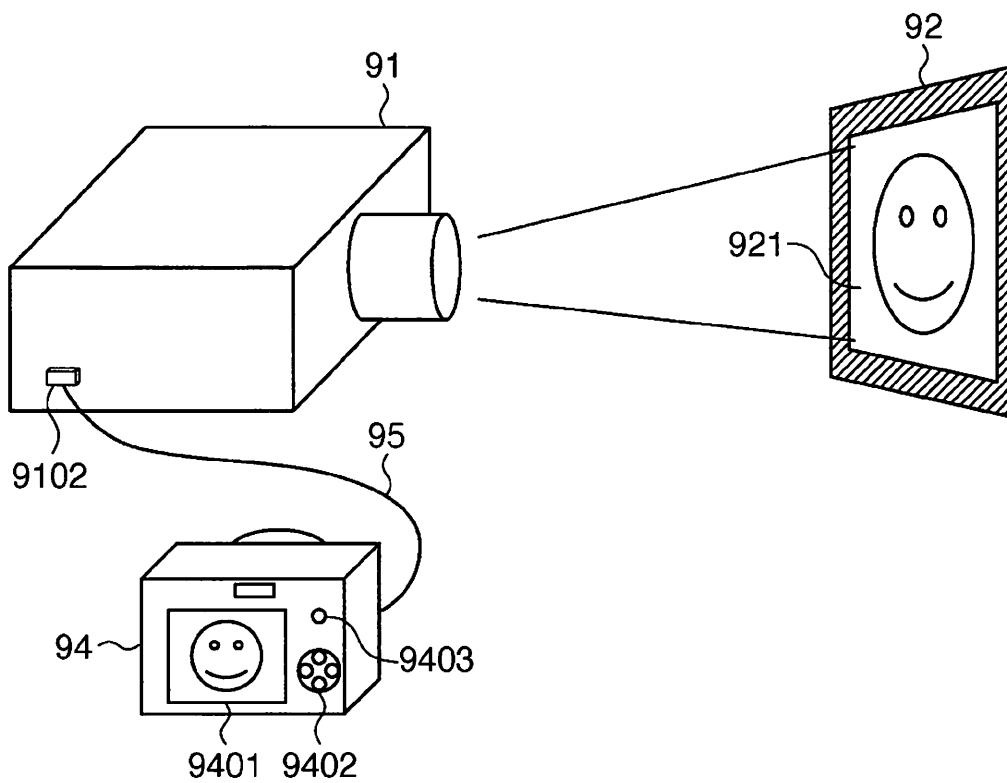
FIG. 15

FIG. 16



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DISPLAY APPARATUS, CONTROL METHOD THEREOF, AND PROGRAM

This application is a continuation of application Ser. No. 13/281,543, filed Oct. 26, 2011, now U.S. Pat. No. 8,078,767, issued Dec. 13, 2011, which is a divisional of application Ser. No. 12/545,270, filed Aug. 21, 2009, which is a continuation of PCT Application No. PCT/JP/2009/055831, filed Mar. 24, 2009.

TECHNICAL FIELD

The present invention relates to a display apparatus, a control method thereof, and a program.

BACKGROUND ART

Conventionally, a display apparatus such as a projector is connected to various devices via, for example, USB (Universal Serial Bus), and displays image data transmitted from these connected devices. Various devices connected to the display apparatus include a semiconductor memory device such as a flash memory device, a PC (Personal Computer), a digital still camera (to be referred to as a "digital camera" hereinafter), and the like.

A case will be explained first with reference to FIGS. 11A to 13C wherein a flash memory as a semiconductor memory device is connected to a projector as a display apparatus, and image data stored in that flash memory is displayed on the projector. FIG. 11A is a schematic view showing an overview when a flash memory 93 is connected to a conventional projector 91 to display an image. FIG. 11B is a schematic view showing details of a control panel 9101. FIG. 12 is a sequence chart showing the operation sequence executed when the flash memory 93 is connected to the projector 91 to display an image. FIGS. 13A to 13C are schematic views exemplifying images to be projected by the projector 91 onto a screen 92.

As shown in FIG. 11A, the projector 91 has the control panel 9101 and a USB connector 9102. As shown in FIG. 11B, the control panel 9101 has an up arrow button 9011, left arrow button 9012, down arrow button 9013, right arrow button 9014, enter button 9015, input button 9016, and power button 9017. The projector 91 accepts operation instructions from the user from various buttons on the control panel 9101. The USB connector 9102 receives the flash memory 93 having a USB connection terminal. This flash memory 93 stores image data to be displayed by the projector 91. By the user plugging the flash memory 93 into the USB connector 9102 and operating the control panel 9101, he or she can browse image data stored in the flash memory 93 as an image 921 on the screen 92.

The operation sequence among the user, flash memory 93, and projector 91 will be described below. Assume that the projector 91 is powered, and the flash memory 93 is not connected to the projector 91 in an advance state. As shown in FIG. 12, the operation sequence by the user, flash memory 93, and projector 91 mainly include steps S200 to S210 which are executed in turn. In step S200, the projector 91 displays a connection request window that requests the user to connect the flash memory 93 to the USB connector 9102 by projecting that window on the screen 92. The connection request window in step S200 displays a message that prompts the user to connect the flash memory 93 as a USB device, as shown in FIG. 13A.

In step S201, the user connects the flash memory 93 to the USB connector 9102. In step S202, a USB communication is established based on the USB standard between the projector

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91 and flash memory 93 which are physically connected via the USB connector 102. In this case, the projector 91 recognizes the flash memory 93 as Mass Storage Class based on the USB standard.

In step S203, the projector 91 reads directory entry information stored in the flash memory 93. In step S204, the projector 91 displays a file selection window that prompts the user to select an image file to be displayed by projecting that window on the screen 92. The file selection window in step S204 is as shown in FIG. 13B, and is a window that displays a file name list of image files stored in the flash memory 93, and a cursor used to select them.

In step S205, the user who confirmed the aforementioned file selection window selects an image file to be displayed by operating the control panel 9101 and issues a display instruction to the projector 91. For example, in step S205 the user gives an instruction to move the cursor by pressing the up or down arrow button 9011 or 9013 on the control panel 9101, and issues a display instruction of an image file selected by the cursor by pressing the enter button 9015.

In step S206, the projector 91 reads data of the image file designated in step S205 from the flash memory 93. In step S207, the projector 91 displays an image based on the image file read in step S206 by projecting that image on the screen 92. As the image displayed in step S207, image data of a landscape or the like captured using a digital camera is stored in advance in the flash memory 93, as shown in FIG. 13C.

In step S208, the user issues a display end instruction to the projector 91 by operating the control panel 9101. More specifically, when the user presses the enter button 9015, a display end instruction is issued to the projector 91. Note that the operations for accepting selection of an image file by the user and displaying the selected image file can be repeated by repeating steps S204 to S208 bounded by the broken line in FIG. 12.

In step S209, the user removes the flash memory 93 from the USB connector 9102. In step S210, the projector 91 clears a display image projected onto the screen 92 (or overwrites the image by a predetermined image such as a menu window) due to removal of the flash memory 93 in step S209. For example, in step S210 the connection request window shown in FIG. 13A is overwritten on an image displayed in steps S204 to S208. As a result, the projector 91 can prompt the user to connect the next device. The user removes the flash memory 93 with the intention to end browsing of image files stored in the flash memory 93. Therefore, since the projector 91 clears an image displayed in steps S204 to S208, it can attain an image display operation according to the user's intention.

Note that patent reference 1 is known as a technique of clearing (overwriting) a display image by a predetermined image in step S210 above. Patent reference 1 discloses a technique for clearing a display image at the end of a communication and a technique for clearing a previous display image at the beginning of a communication.

A case will be exemplified below wherein another example of various devices to be connected is a digital camera. Note that a case will be exemplified below with reference to FIGS. 14A and 14B, and FIG. 15 wherein a digital camera is connected to a printer, and the printer outputs an image based on image data stored in that digital camera. As a typical example in this case, the CIPA DC-001-2003 standard (to be referred to as "PictBridge" hereinafter) is available. In a method of outputting an image using this PictBridge, even a user unskilled in operations of devices such as PCs can output an

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image using a printer by readily operating a digital camera. An image output operation using the PictBridge will be described below.

FIG. 14A is a schematic view showing an overview when a digital camera 94 is connected to a printer 96 to output an image. FIG. 14B is a block diagram showing the arrangement associated with a communication between the printer 96 and digital camera 94. FIG. 15 is a sequence chart showing the operation sequence when the digital camera 94 is connected to the printer 96 to output an image.

As shown in FIG. 14A, the printer 96 has a discharge port 9601 and USB connector 9602. The discharge port 9601 discharges a paper sheet 9603 after image formation. To the USB connector 9602, the digital camera 94 is connected via a USB cable 95. The digital camera 94 has a liquid crystal panel screen 9401, operation member 9402, and PictBridge button 9403. The liquid crystal panel screen 9401 displays a preview of an image or the like transferred via the PictBridge. The operation member 9402 accepts an image selection instruction from the user. The PictBridge button 9403 is a button which accepts an instruction to start PictBridge transfer from the user. An image based on image data stored in the digital camera 94 is output onto a paper sheet in the printer 96 in such a manner that an image output instruction is output to the printer 96 by an operation on the digital camera 94 side, and image data to be output is transmitted from the digital camera 94 to the printer 96.

The operation sequence among the user, digital camera 94, and printer 96 will be described below. As shown in FIG. 15, the operation sequence by the user, digital camera 94, and printer 96 mainly includes steps S500 to S509, which are executed in turn. In step S500, the user connects the digital camera 94 and printer 96 via the USB cable 95. In step S501, a USB communication is established based on the USB standard between the digital camera 94 and printer 96 which are physically connected via the USB cable 95. In this case, the printer 96 recognizes the digital camera 94 as a capture device of Imaging Class based on the USB standard.

In step S502, a PictBridge connection is established between the digital camera 94 and printer 96. More specifically, a connection is established in a PTP (Picture Transfer Protocol) layer, device information is exchanged, and so forth. Then, a communication state as a PictBridge sequence transits to an idle state, and the printer 96 waits for issuance of a print job by the digital camera 94.

In step S503, the user issues a print instruction via the PictBridge by operating the digital camera 94. More specifically, this print instruction in step S503 is issued when the user presses the PictBridge button 9403. In step S504, the digital camera 94 transmits a PictBridge print job to the printer 96 based on the print instruction in step S503, and the printer 96 starts the operation of that print job.

In step S505, the printer 96 requests the digital camera 94 to transmit file information to be printed in accordance with the print job in step S504, and acquires that file information. Likewise, in step S506 the printer 96 requests the digital camera 94 to transmit a file image (image data) to be printed in accordance with the print job in step S504, and acquires that file image.

In step S507, the printer 96 executes decoding, scaling, print processing, and the like of an image indicated by the file acquired in steps S505 and S506, and outputs the paper sheet 9603 after image formation from the discharge port 9601. In step S508, the printer 96 notifies the digital camera 94 of an idle state upon completion of the print job. Note that the operations for accepting selection of an image to be printed

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from the user, and printing out the selected image can be repeated by repeating steps S503 to S508 bounded by the broken line in FIG. 15.

In step S509, the user removes the USB cable 95 from the printer 96 or digital camera 94. Note that a device, which can control a communication session and logically disconnects a communication connection like the digital camera 94, often disconnects a communication like closing of a communication session in addition to a physical communication disconnection by, for example, removal of the USB cable 95. For example, when the battery remaining amount lowers during the aforementioned PictBridge sequence, the digital camera 94 side may execute control for disconnecting a USB communication so as to reduce consumption power.

A communication disconnection on the digital camera 94 side will be explained below by exemplifying the arrangement associated with a communication between the digital camera 94 and printer 96. As shown in FIG. 14B, a USB host controller 9604 on the printer 96 side is connected to a USB device controller 9407 on the digital camera 94 side via the USB cable 95. The USB cable 95 includes four signal lines, that is, a VBUS line 9501, D+ line 9502, D- line 9503, and GND line 9504.

The D+ line 9502 and D- line 9503 are used to transmit differential signals required to make a USB data communication, and also indicate a device connection state by a voltage in a steady state. The D+ line 9502 and D- line 9503 are respectively pulled down by resistors 9606 and 9605 on the printer 96 side, and indicate a Low voltage when no USB cable is connected. Thus, the printer 96 recognizes a USB non-connection state. On the other hand, when the printer 96 and digital camera 94 are connected, the D+ line 9502 is pulled up by a resistor 9406 via a switch 9405 on the digital camera 94 side. Then, when the switch 9405 is in a connection state, the D+ line 9502 indicates a High voltage. As a result, the printer 96 recognizes a USB connection state.

A CPU 9404 controls the switch 9405 on the digital camera 94 side. Note that the CPU 9404 executes the following processing for the purpose of, for example, reducing consumption power of the digital camera 94. For example, in step S508 in which the PictBridge sequence transits to an idle state upon completion of the print job, the CPU 9404 controls the switch 9405 on the digital camera 94 side to stop to pull up the D+ line 9502. In this case, the D+ line 9502 indicates a Low voltage since it is pulled down on the printer 96 side. For this reason, the USB host controller 9604 recognizes a USB non-connection state and disconnects a USB communication, since this state is electrically equivalent to cable removal in association with the D+ line 9502. That is, the communication session between the digital camera 94 and printer 96 is closed by the control on the digital camera 94 side for the purpose of, for example, reducing consumption power.

When a communication disconnection is made on the digital camera 94 side, as described above, the user meets the same behavior as that when the USB cable 95 is removed at the end of the print processing of the printer 96. That is, the PictBridge sequence reaches the same state as that when the process reaches step S509.

Note that the PictBridge that assumes printing has been exemplified, but the PictBridge is applicable to a display on a display apparatus such as a projector or television. For example, when the digital camera 94 is connected to the projector 91 to display an image, as shown in FIG. 16, the PictBridge allows the projector 91 to project and display an image transmitted from the digital camera 94 by a simple operation on the digital camera 94 side. Like in the case in which the printer 96 and digital camera 94 are connected,

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when a communication is disconnected on the digital camera 94 side, the user meets the same behavior as that when the USB cable 95 is removed. That is, the projector 91 clears an image which was transmitted from the digital camera 94 and was displayed immediately before the communication dis-connection by displaying, for example, the connection request window.

As a technique for disconnecting a USB communication from the device side, patent reference 2 is known. Patent reference 2 discloses a technique for disconnecting a communication by stopping to pull up a data line on the device side based on a disconnection instruction from the host side. Patent Reference 1: Japanese Patent Laid-Open No. 7-123379

Patent Reference 2: Japanese Patent Laid-Open No. 2006-235993

DISCLOSURE OF THE INVENTION

Problems that the Invention is to Solve

As described above, the conventional display apparatus can be connected to various devices, and can display image data stored in a connected device. However, independently of the device class to be connected, when a communication is disconnected, the display operation of an image transmitted from that device ends. For this reason, in addition to the image display end operation that the user intended by removing the flash memory or USB cable, the image display operation often ends without the intention of the user by the control on the device side that logically disconnects a communication connection.

The present invention handles at least one of such conventional problems. That is, the present invention provides a display apparatus, which can control to continue or end a display operation according to a device class when a communication connection with a device is disconnected during execution of the display operation based on data transmitted from the connected device, a control method thereof, and a program.

Means of Solving the Problems

According to the first invention of the present application, there is provided a display apparatus characterized by comprising a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, characterized in that the control unit acquires class information indicating a class of the external device from the external device via the connection unit, controls the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the second invention of the present application, there is provided a control method of a display apparatus which comprises a display unit, a connection unit configured to connect an external device to be able to communicate with

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the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, the method characterized by comprising the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the third invention of the present application, there is provided a display apparatus characterized by comprising a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, characterized in that the control unit acquires class information indicating a class of the external device from the external device via the connection unit, controls the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controls the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

According to the fourth invention of the present application, there is provided a control method of a display apparatus which comprises a display unit, a connection unit configured to connect an external device to be able to communicate with the external device, and a control unit configured to control the display unit to make a display based on data received from the external device with which a communication connection is established via the connection unit, the method characterized by comprising the control step of acquiring class information indicating a class of the external device from the external device via the connection unit, controlling the display unit to end the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is a predetermined class, and controlling the display unit to continue the display based on the data received from the external device at the time of disconnection of the communication connection with the external device if the class of the external device indicated by the class information is not the predetermined class.

Effects of the Invention

According to the present invention, when a communication connection with a device is disconnected during execution of a display operation based on data transmitted from the connected device, the display operation can be controlled to continue or end according to the device class.

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Other features and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings. Note that the same reference numerals denote the same or similar components throughout the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. 1A is a view exemplifying a use mode of a display apparatus according to the present invention, that is, a schematic view exemplifying a use mode upon connecting a flash memory to a display apparatus to display an image;

FIG. 1B is a view exemplifying a use mode of the display apparatus according to the present invention, that is, a schematic view exemplifying a use mode upon connecting a digital camera to the display apparatus to display an image;

FIG. 2 is a block diagram illustrating the functional arrangement of the display apparatus;

FIG. 3 is a schematic view exemplifying an input selection menu window;

FIG. 4A is a flowchart showing the processing of the display apparatus;

FIG. 4B1 is a flowchart showing the processing of the display apparatus when "Mass Storage Class" is determined in step S804 in FIG. 4A;

FIG. 4B2 is a flowchart showing the sequel of FIG. 4B1;

FIG. 4C1 is a flowchart showing the processing of the display apparatus when "Imaging Class" is determined in step S804 in FIG. 4A;

FIG. 4C2 is a flowchart showing the sequel of FIG. 4C1;

FIG. 5A is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying an input waiting window;

FIG. 5B is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying a display of image data from the digital camera;

FIG. 5C is a schematic view showing an example of a projected display window, that is, a schematic view exemplifying an incompatibility window;

FIG. 6A is a flowchart showing processing of the first modification (corresponding to FIG. 4C1) in the display apparatus;

FIG. 6B is a flowchart showing processing of the first modification (corresponding to FIG. 4C2) in the display apparatus;

FIG. 7 is a block diagram showing the peripheral arrangement of a CPU and USB connector 102 of the second modification in the display apparatus;

FIG. 8A is a flowchart showing processing of the second modification (continued from any of FIGS. 8B1 to 8C2) in the display apparatus;

FIG. 8B1 is a flowchart showing processing of the second modification (corresponding to FIG. 4B1) in the display apparatus;

FIG. 8B2 is a flowchart showing processing of the second modification (corresponding to FIG. 4B2) in the display apparatus;

FIG. 8C1 is a flowchart showing processing of the second modification (corresponding to FIG. 4C1) in the display apparatus;

FIG. 8C2 is a flowchart showing processing of the second modification (corresponding to FIG. 4C2) in the display apparatus;

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FIG. 9A is a flowchart showing processing of the third modification (corresponding to FIG. 8A) in the display apparatus;

FIG. 9B is a flowchart showing processing of the third modification (corresponding to FIG. 4A) in the display apparatus;

FIG. 10A is a flowchart showing processing of the fourth modification (corresponding to FIG. 9A) in the display apparatus;

FIG. 10B is a flowchart showing processing of the fourth modification (corresponding to FIG. 9B) in the display apparatus;

FIG. 11A is a schematic view showing an overview when a flash memory is connected to a conventional projector to display an image;

FIG. 11B is a schematic view showing details of a control panel;

FIG. 12 is a sequence chart showing the operation sequence when the flash memory is connected to the projector to display an image;

FIG. 13A is a schematic view exemplifying a connection request window projected by the projector onto a screen;

FIG. 13B is a schematic view exemplifying a file selection window projected by the projector onto the screen;

FIG. 13C is a schematic view exemplifying a display of image data which is stored in the flash memory, and is projected by the projector onto the screen;

FIG. 14A is a schematic view showing an overview when a digital camera is connected to a printer to output an image;

FIG. 14B is a block diagram showing the arrangement associated with a communication between the printer and digital camera;

FIG. 15 is a sequence chart showing the operation sequence when the digital camera is connected to the printer to output an image; and

FIG. 16 is a schematic view showing an overview when a digital camera is connected to a projector to display an image.

DESCRIPTION OF REFERENCE NUMERALS

- 1 . . . display apparatus
- 2 . . . screen
- 3 . . . flash memory
- 4 . . . digital camera
- 5 . . . USB cable

BEST MODE FOR CARRYING OUT THE INVENTION

An embodiment of the present invention will be described hereinafter with reference to the drawings, but the present invention is not limited to the embodiment to be described hereinafter. The embodiment of the present invention presents one aspect of the invention, and does not limit the scope of the invention.

A use mode of a display apparatus according to the present invention will be described first with reference to FIGS. 1A and 1B which exemplify the use modes of a display apparatus 1. As shown in FIG. 1A, as a use mode of the display apparatus 1, a flash memory 3 is connected to a USB connector 102 of the display apparatus 1, and an image stored in the flash memory 3 is projected and displayed as an image 21 on a screen 2. A control panel 101 includes various buttons used to accept operation instructions from the user. The user can browse image data stored in the flash memory 3 as the image 21 on the screen 2 by plugging the flash memory 3 into the USB connector 102 and operating the control panel 101.

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Also, as shown in FIG. 1B, as another use mode, a digital camera 4 is connected to the USB connector 102 of the display apparatus 1 via a USB cable 5, and an image stored in the digital camera 4 is projected and displayed as an image 22 on the screen 2. The digital camera 4 has a liquid crystal panel screen 401, operation member 402, and operation button 403. The liquid crystal panel screen 401 displays a preview of an image and the like to be transferred to the display apparatus 1. The operation member 402 accepts a selection instruction of an image from the user. The operation button 403 is a button used to accept a transfer start instruction to the display apparatus 1 from the user. A projection display operation by the display apparatus 1 based on image data stored in the digital camera 4 is attained in such a manner that an image display instruction by an operation on the digital camera 4 side is output from the digital camera 4 to the display apparatus 1, and image data to be output is transmitted from the digital camera 4 to the display apparatus 1.

The user who uses the display apparatus 1 can appreciate an image captured by the digital camera 4 by projecting and displaying it onto the screen or can make a presentation for other users by projecting an image which is saved in the flash memory 3 and represents briefing paper.

Details of the display apparatus 1 will be described below with reference to FIG. 2. FIG. 2 is a block diagram illustrating the functional arrangement of the display apparatus 1. As shown in FIG. 2, a video signal is input to a video terminal 103 particularly via a video cable (not shown). The input video signal is converted into a digital video signal by an AD converter 104 (Analog-To-Digital) connected to the video terminal 103. A CPU 107 (to be described later) sets sampling parameters (a frequency, phase, etc.) upon AD conversion. Note that when an input video signal is a digital video signal, the AD converter 104 is not required, and the present invention is applicable when an appropriate receiver is used as needed.

The converted digital video signal is input to a video processor 105 connected to the AD converter 104. The video processor 105 applies video adjustment processing such as resolution conversion processing, contrast adjustment, and brightness, sharpness, and gamma corrections, and OSD image superimposing processing of a menu and the like. Note that "OSD" is an abbreviation for "On Screen Display".

The CPU 107 controls the operation of the video processor 105. Furthermore, the video processor 105 can receive arbitrary image data from the CPU 107. For example, when the CPU 107 transmits image data received by a USB host controller 110 to the video processor 105, the video processor 105 can output that video as a video signal.

The video signal output from the video processor 105 is input to a liquid crystal driver 106, and is converted into signals (e.g., RGB video signals) suited to drive liquid crystal panels 117, 118, and 119. The liquid crystal panels 117, 118, and 119, which respectively represent three primary colors, that is, Red, Green, and Blue, include liquid crystal pixels arranged in a matrix pattern, and form images based on input signals. The liquid crystal panels 117, 118, and 119 are arranged to transmit light emitted from a lamp (not shown) through them, and modulate light coming from the lamp by images formed based on the input signals.

A projection lens 120 projects and displays light modulated by the liquid crystal panels 117, 118, and 119 onto an external device (e.g., the screen 2). The control panel 101 has an up arrow button, left arrow button, down arrow button, right arrow button, enter button, input button, and power button as in the control panel 9101 that has been explained with reference to FIG. 11B. Pressing information of each

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button on the control panel 101 is sent to the CPU 107 as an operation instruction by the user. More specifically, that information is used to control a cursor movement, an enter operation, and the like of a menu on a display window.

The USB host controller 110 is a circuit which makes a USB communication with an external device using a VBUS line 111, D+ line 112, D- line 113, and GND line 114, which are specified in the USB standard. In the USB host controller 110, data to be transmitted/received is input/output by the CPU 107. The D+ line 112 and D- line 113 are USB communication lines used to make a differential communication, and are respectively pulled down by resistors 115 and 116. The VBUS line 111, D+ line 112, D- line 113, and GND line 114 are connectable to an external device via the USB connector 102 as a connection unit. The USB connector 102 serves as a USB interface which can connect a USB device as an external device. Therefore, the display apparatus 1 and USB device can communicate with each other via the USB connector 102.

The CPU 107 (Central Processing Unit) centrally controls the display apparatus 1. More specifically, the CPU 107 manages to start up and shut down the display apparatus 1, and controls the respective units such as the AD converter 104, video processor 105, USB host controller 110, and liquid crystal driver 106. A ROM 108 (Read Only Memory) stores program codes and various data required to operate the CPU 107. A CPU 107 (Random Access Memory) provides a work area required to let the RAM 109 operate.

The CPU 107 can select a video source to be displayed from the following two sources in addition to the startup processing of respective blocks after power-ON. The first video source is a video picture signal input from the video terminal 103. The second video source is image data transmitted from a device connected via the USB connector 102. The CPU 107 controls the video processor 105 to project an input selection menu window in response to a user's operation on the control panel 101 as a trigger. FIG. 3 is a schematic view exemplifying the input selection menu window. As shown in FIG. 3, the input selection menu window presents a selection menu of "external video" and "USB" as a video source to be displayed to the user.

After that, the CPU 107 receives a selection instruction input by a user's operation on the control panel 101, and executes a video source switching operation. In this video source switching operation, when "USB" is selected, and the projection display operation of image data from the flash memory 3 or digital camera 4 connected to the display apparatus 1 is to be executed, the CPU 107 sequentially executes the flowcharts including steps S801 to S832 exemplified in FIGS. 4A to 4C2. The processing of these flowcharts is executed until the power switch of the display apparatus 1 is turned off or until the input selection menu is displayed again, and "external video" is selected as a video source.

As shown in FIGS. 4A to 4C2, if the processing is started (S801), the CPU 107 controls the video processor 105 to project and display a USB device connection request window onto the screen 2 (S802). This connection request window is as has been described with reference to FIG. 13A, and prompts the user to connect a USB device. The connection request window is a kind of pattern image, and is displayed based on pattern image data stored in advance in the ROM 108.

The CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB device is communication-connected via the USB connector 102, and a USB communication is established (S803). If it is determined in

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step S803 that a USB communication is established, the process to be executed by the CPU 107 advances to the next step.

The CPU 107 sends an inquiry to the USB host controller 110 to determine a class of the communication-connected USB device (S804). This class is determined based on class information transmitted from the USB device when the USB host controller 110 establishes a USB communication with that USB device connected via the USB connector 102. More specifically, the class information of the USB device includes USB Mass Storage Class indicating the class of a device which is a simple storage and physically disconnects a communication connection. Also, the class information includes USB Imaging Class (often also called Imaging Device) indicating the class of a device which can execute communication control with the connected display apparatus 1 and can logically disconnect a communication connection depending on devices. Note that USB Mass Storage Class will be referred to as Mass Storage Class, and USB Imaging Class will be referred to as Imaging Class hereinafter. For example, the flash memory 3 transmits class information indicating Mass Storage Class to the display apparatus 1 at the time of connection, and the digital camera 4 transmits class information indicating Imaging Class to the display apparatus 1 at the time of connection. If the class information indicates Mass Storage Class in step S804, the process to be executed by the CPU 107 advances to step S805; if the class information indicates Imaging Class, the process advances to step S817; otherwise, the process advances to step S831.

FIG. 4A shows "Mass Storage Class" and "Imaging Class" as the device classes, but the present invention is not limited to these classes. For example, the display apparatus 1 may store a class for which an image display operation is to be continued and a class for which the operation is to be ended (or one of these classes) at the time of disconnection of a communication.

The CPU 107 executes a sequence of steps S805 to S816 when the communication-connected USB device is a USB mass storage such as the flash memory 3. In step S805, the CPU 107 reads out directory entry information stored in the USB device via the USB host controller 110.

In step S806, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S805 in this case). If it is determined in step S806 that the USB communication was disconnected, the process to be executed by the CPU 107 returns to step S802.

In step S807, the CPU 107 controls the video processor 105 to display a file selection window that enumerates image file names based on the readout directory entry information. This file selection window is as has been described with reference to FIG. 13B, and is a window that displays a file name list of image files stored in the flash memory 3 and a cursor used to select them. The display apparatus 1 prompts the user to select an image file to be displayed of those stored in the flash memory 3 using this file selection window.

The CPU 107 determines in step S808 whether or not a USB communication with the USB device was disconnected, as in step S806. The CPU 107 determines in step S809 whether or not the user has made an operation on the control panel 101. If it is determined in step S809 that the user has not made any operation, the process to be executed by the CPU 107 returns to step S808.

In step S810, the CPU 107 updates the file selection window based on the user's operation on the control panel 101. More specifically, when the user presses the up or down arrow button on the control panel 101, the CPU 107 reconfigures

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and displays a window on which the cursor to be rendered to select a file of interest has been moved.

The CPU 107 determines in step S811 based on a user's operation on the control panel 101 whether or not the user has made an operation to select an image file to be displayed. More specifically, when the user presses the enter button on the control panel 101, the CPU 107 determines that an image file in a cursor line is determined as that to be displayed. If no image file selection operation is made, the process to be executed by the CPU 107 returns to step S808.

In step S812, the CPU 107 reads out a file image of the image file selected in step S811 from the USB device via the USB host controller 110. The CPU 107 determines in step S813 whether or not a USB communication with the USB device was disconnected, as in step S806.

In step S814, the CPU 107 controls the video processor 105 to project and display an image based on the readout file image on the screen 2, after the image is scaled to match the resolution of the liquid crystal panels 117, 118, and 119. The image which is projected and displayed on the screen 2 is the same as that which has been described with reference to FIG. 13C, and is based on image data stored in advance in the flash memory 3.

The CPU 107 determines in step S815 whether or not a USB communication with the USB device was disconnected, as in step S806. The CPU 107 determines in step S816 based on a user's operation on the control panel 101 whether or not the user gives the instruction to end the image display operation. More specifically, the CPU 107 makes this determination by acquiring pressing information of the enter button on the control panel 101. If the user does not give the instruction to end the image display operation, the process to be executed by the CPU 107 returns to step S815. If the user gives the instruction to end the image display operation, the process to be executed by the CPU 107 returns to step S807, and the file selection window is displayed again to prompt the user to select another image file.

On the other hand, the CPU 107 executes a sequence of steps S817 to S830 when the connected USB device corresponds to, for example, Imaging Class such as the digital camera 4 compatible to the PictBridge. Note that the PictBridge-compatible digital camera 4 will be exemplified below, and a case will be described wherein the scheme of the PictBridge is diverted, and the projection display operation of the display apparatus 1 is made using a print instruction (image output) from the digital camera 4. In step S817, the CPU 107 executes PictBridge connection processing with respect to the USB device via the USB host controller 110. Note that this processing corresponds to step S502, which has been explained with reference to FIG. 15.

In step S818, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S817 in this case). If it is determined in step S818 that the USB communication was disconnected, the process to be executed by the CPU 107 advances to step S830.

The CPU 107 determines in step S819 whether or not the PictBridge connection processing in step S817 has succeeded, and a PictBridge connection is established. If a PictBridge connection is not established because, for example, the USB device to be connected is incompatible to the PictBridge, the process to be executed by the CPU 107 advances to step S831.

In step S820, the CPU 107 controls the video processor 105 to project and display an input waiting window. This input waiting window is a window used to prompt the user to print an image file (or to transfer an image to a projector) by the

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PictBridge function from the digital camera side, as shown in FIG. 5A. Note that this step S820 corresponds to an idle state in which the control waits for a "print" instruction in step S503 described with reference to FIG. 15.

The CPU 107 determines in step S821 whether or not a USB communication with the USB device was disconnected, as in step S818. The CPU 107 determines in step S822 whether or not a print job start communication is made from the USB device via the USB host controller 110. This communication corresponds to step S504 which has been explained with reference to FIG. 15. If it is determined in step S822 that no start instruction is issued, the process to be executed by the CPU 107 returns to step S821.

The CPU 107 determines in step S823 whether or not a USB communication with the USB device was disconnected, as in step S818. In step S824, the CPU 107 acquires information of an image file to be output included in the print job from the USB device via the USB host controller 110. This step S824 corresponds to step S505 which has been described with reference to FIG. 15.

The CPU 107 determines in step S825 whether or not a USB communication with the USB device was disconnected, as in step S818. In step S826, the CPU 107 acquires an image of the image file included in the print job from the USB device via the USB host controller 110. This step S826 corresponds to step S506 which has been described with reference to FIG. 15.

The CPU 107 determines in step S827 whether or not a USB communication with the USB device was disconnected, as in step S818. In step S828, the CPU 107 controls the video processor 105 to project and display the acquired image on the screen 2, after the image is scaled to match the resolution of the liquid crystal panels 117, 118, and 119. The image, which is projected and displayed on the screen 2, is an image based on image data captured by the digital camera, and is an image of a person or the like, as shown in, for example, FIG. 5B.

In step S829, the CPU 107 notifies the USB device, via the USB host controller 110, that a communication state based on the PictBridge connection transits to an idle state. This notification in step S829 corresponds to step S508 which has been described with reference to FIG. 15.

If it is determined in step S818, S821, S823, S825, or S827 that the USB communication was disconnected, the process of the CPU 107 advances to step S830. The CPU 107 determines in step S830 whether or not the projection display operation of an image based on the image acquired from the USB device is in progress (i.e., whether or not the process has passed step S828). If the projection display operation of the image is in progress, the process of the CPU 107 returns to step S803; otherwise, the process of the CPU 107 returns to step S802.

On the other hand, if an incompatible device class is determined in step S804, or if it is determined in step S819 that a PictBridge connection is not established, the process of the CPU 107 advances to step S831. In step S831, the CPU 107 controls to project and display an incompatibility window. This incompatibility window is a window used to notify the user that the connected USB device is incompatible to the display apparatus 1, as shown in FIG. 5C.

In step S832, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected. This determination in step S832 continues until the USB communication is disconnected, and if the USB communication is disconnected, the process of the CPU 107 returns to step S802.

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As described above, when a USB communication is disconnected while the display apparatus 1 is connected to a USB device such as a flash memory device, and executes the projection display operation of image data stored in that device, the display apparatus 1 overwrites an image whose projection display operation is in progress by the connection request window (S802). When the class of the connected device corresponds to, for example, the flash memory device, the USB connection is disconnected mainly by removal of the device by the user. Furthermore, the user removes the device with the intention to end the projection display operation. Hence, when the USB connection is disconnected, it is preferable for the display apparatus 1 to overwrite an image, whose projection display operation is in progress, by the connection request window without continuing the projection display operation.

On the other hand, when a USB connection is disconnected while the display apparatus 1 is connected to a USB device such as a digital camera, and executes the projection display operation of image data stored in that device, the display apparatus 1 continues to display an image, whose projection display operation is in progress, without being overwritten by the connection request window (transition from step S830 to step S803). When the class of the connected device corresponds to, for example, the digital camera, the USB communication may be disconnected either by removal of the device by the user or by control on the USB device side. Therefore, since the USB connection is disconnected by not only removal of the device by the user who intended to end the projection display operation, it is preferable for the display apparatus 1 to continue to display an image, whose projection display operation is in progress, when the USB connection is disconnected.

That is, when a communication is disconnected while the display apparatus 1 executes the projection display operation based on image data from the connected device, the display apparatus 1 controls whether or not to continue the display operation of the image whose projection display operation is in progress according to the class of the connected device. Therefore, the display apparatus 1 can eliminate the opportunity of a display state which is likely to occur depending on the class of the connected device and is not intended by the user. For example, the display apparatus 1 can eliminate occurrence of situations that the image display operation is unwantedly ended in a case in which the user intends to browse images and that the image display operation is unwantedly continued in a case in which the user intends to end image browsing. Note that, in this embodiment, the image of the connection request window is used as an overwrite image. Alternatively, for example, a solid black or blue-black pattern image may be used.

[First Modification]

As the first modification of the aforementioned embodiment, a case will be described wherein the processes of FIGS. 4C1 and 4C2 of those to be executed by the CPU 107 of the display apparatus 1 exemplified in FIGS. 4A to 4C2 are modified like the flowcharts shown in FIGS. 6A and 6B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided.

As shown in FIGS. 6A and 6B, in the first modification, steps S818, S823, S825, and S827 in the sequence of the CPU 107 exemplified in FIGS. 4C1 and 4C2 are respectively replaced by steps S1318, S1323, S1325, and S1327.

In step S1318, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S817 in this case). If it is determined in

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step S1318 that the USB communication was disconnected, the process to be executed by the CPU 107 returns to step S802. Note that the processing contents in steps S1323, S1325, and S1327 are the same as in step S1318.

In step S821, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S820 in this case). If it is determined in step S821 that the USB communication was disconnected, the process to be executed by the CPU 107 advances to step S830. That is, when the USB communication is disconnected at the display timing of the input waiting window, and in an idle state of the communication, since the process of the CPU 107 temporarily advances to step S830, an image can be prevented from being immediately overwritten by the connection request window.

As described above, in the first modification, the following processes of the display apparatus 1 executed when a communication is disconnected while the display apparatus 1 is connected to the PictBridge-compatible device and executes the projection display operation of an image stored in that device are different from the aforementioned embodiment. When the PictBridge connection is not in an idle state, that is, a communication is underway at the time of the aforementioned communication disconnection, the display apparatus 1 overwrites an image whose projection display operation is in progress by the connection request window. When the PictBridge connection is in an idle state, that is, a communication is not underway, an image whose projection display operation is in progress is continuously displayed.

When the PictBridge connection is in a non-idle state, that is, a communication is underway, a USB communication is more likely to be disconnected at that time not by control on the USB device side but by, for example, removal of the USB device by the user. Therefore, when a communication is disconnected during the USB communication, it is preferable for the display apparatus 1 to overwrite an image, whose projection display operation is in progress, by the connection request window without continuously displaying the image. When a communication is disconnected while the USB communication is in an idle state, such disconnection may be caused either by removal of the USB device by the user or by control on the USB device side. Therefore, since a USB communication in an idle state is disconnected by not only removal of the device by the user who intends to end the projection display operation, it is preferable for the display apparatus 1 to continue to display an image whose projection display operation is in progress.

[Second Modification]

The second modification of the aforementioned embodiment will be described below. In the second modification, the peripheral arrangement of the CPU 107 and USB connector 102 of the display apparatus 1 exemplified in FIG. 2 is modified, as shown in FIG. 7. Also, in the second modification, the processes to be executed by the CPU 107 of the display apparatus 1 exemplified in FIGS. 4B1 to 4C2 are modified, as shown in the flowcharts shown in FIGS. 8A to 8C2. Note that the same reference numerals denote the same components, and a repetitive description thereof will be avoided.

As shown in FIG. 7, the display apparatus 1 includes an insertion detector 121 which detects insertion of a USB plug in the USB connector 102. In the insertion detector 121, a conductive terminal 1212 having a projection 1211, which is arranged at a position where the projection 1211 physically interferes with a USB plug, and a grounded conductive terminal 1213 are arranged in the USB connector 102 to be brought into contact with each other when a USB plug is not

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inserted. The conductive terminal 1212 is pulled up by a resistor 122, and is connected to an input port of the CPU 107.

Therefore, in the insertion detector 121, when a USB plug is inserted into the USB connector 102, the USB plug pushes up the conductive terminal 1212, and the conductive terminals 1212 and 1213 are open. Hence, the CPU 107 can recognize insertion/removal of the USB plug to/from the USB connector 102.

In the second modification, steps S806, S808, S813, S815, S818, S821, S823, S825, and S827 shown in FIGS. 4B1 to 4C2 are changed, as shown in FIGS. 8B1 to 8C2, and FIG. 8A having steps S1530 and S1533 is added.

In step S1506, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not a USB communication with the USB device was disconnected in the previous process (step S805 in this case). If it is determined in step S1506 that the USB communication was disconnected, the process to be executed by the CPU 107 advances to step S1530. Note that the processing contents in steps S1508, S1513, S1515, S1518, S1521, S1523, S1525, and S1527 are the same as in step S1506.

The CPU 107 determines in step S1530 whether or not the projection display operation of an image based on image data acquired from the USB device is in progress (that is, whether or not the process has passed step S814 or S828). If the projection display operation of the image is in progress, the process of the CPU 107 advances to step S1533; otherwise, the process of the CPU 107 returns to step S802.

The CPU 107 determines in step S1533 using the insertion detector 121 whether or not a USB plug is physically removed from the USB connector 102. If it is determined in step S1533 that the USB plug is physically removed, the process of the CPU 107 returns to step S802. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU 107 returns to step S803.

As described above, in the second modification, when the USB plug is physically removed and a USB communication is disconnected during the projection display operation of image data stored in the connected USB device, the display apparatus 1 overwrites the image whose projection display operation is in progress by the connection request window. Note that when a USB communication is disconnected not by physical removal of the USB plug, the display apparatus 1 does not overwrite the image whose projection display operation is in progress by the connection request window. Thus, the display apparatus 1 can eliminate occurrence of situations that the image display operation is unwantably ended in a case in which the user intends to browse images and that the image display operation is unwantably continued in a case in which the user intends to end image browsing.

[Third Modification]

The third modification, which further modifies the processing of the aforementioned second modification, will be described below with reference to the flowcharts shown in FIGS. 9A and 9B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided. As shown in FIGS. 9A and 9B, in the third modification, step S1533 is replaced by step S1633 in the sequence of the CPU 107 exemplified in FIG. 8A (FIG. 9A), and steps S1634 to S1636 are added in the sequence of the CPU 107 exemplified in FIG. 4A (FIG. 9B).

The CPU 107 determines in step S1633 using the insertion detector 121 whether or not a USB plug is physically removed from the USB connector 102. If it is determined in step S1633 that the USB plug is physically removed, the process of the CPU 107 returns to step S802. On the other hand, if it is

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determined that the USB plug is not physically removed, the process of the CPU 107 advances to step S1634.

In step S1634, the CPU 107 sets and starts a timer which performs a count-down operation for a predetermined period (second period) specified in advance in the ROM or the like. If the CPU 107 determines in step S1635 that the timer started in step S1634 reaches a time-out, or the user issues an instruction on the control panel 101, the process returns to step S802.

In step S1636, the CPU 107 sends an inquiry to the USB host controller 110 to determine whether or not the USB device is connected, and a USB communication is established. If it is determined in step S1636 that the USB communication is established, the process of the CPU 107 advances to step S804. On the other hand, if it is determined that the USB communication is not established, the process of the CPU 107 returns to step S1635. Therefore, in steps S1634 to S1636, the processing waits before the user issues an instruction or the second period set by the timer elapses until the USB communication is established.

As described above, in the third modification, when the USB plug is physically removed and the USB communication is disconnected while the projection display operation of image data stored in the connected USB device is in progress, the display apparatus 1 overwrites the image whose projection display operation is in progress by the connection request window. On the other hand, when it is determined that the USB plug is not physically removed, the image whose projection display operation is in progress is not overwritten by the connection request window until the second period elapses or the user issues an instruction. Hence, the display apparatus 1 can eliminate occurrence of situations that the image display operation is unwantedly ended in a case in which the user intends to browse images and that the image display operation is unwantedly continued in a case in which the user intends to end image browsing.

[Fourth Modification]

The fourth modification that further modifies the aforementioned third modification will be described below with reference to the flowcharts shown in FIGS. 10A and 10B. Note that the same step numbers denote the same processes, and a repetitive description thereof will be avoided. As shown in FIGS. 10A and 10B, in the fourth modification, step S1633 is replaced by step S1733 in the sequence of the CPU 107 exemplified in FIG. 9A (FIG. 10A), and step S1737 is added to the sequence of the CPU 107 exemplified in FIG. 9B (FIG. 10B).

The CPU 107 determines in step S1733 using the insertion detector 121 whether or not a USB plug is physically removed from the USB connector 102. If it is determined in step S1733 that the USB plug is physically removed, the process of the CPU 107 advances to step S1737. On the other hand, if it is determined that the USB plug is not physically removed, the process of the CPU 107 advances to step S1634.

In step S1737, the CPU 107 sets and starts a timer which performs a count-down operation for a predetermined period (first period) which is set in advance in the ROM or the like, and is shorter than the second period set in step S1634.

As described above, in the fourth modification, when the USB plug is physically removed, and a USB communication is disconnected while the projection display operation of image data stored in the connected USB device is in progress, the display apparatus 1 overwrites the image whose projection display operation is in progress by the connection request window. The connection request window is overwritten when the first period set to be shorter than the second period elapses or when the user issues an instruction. On the other hand, when it is determined that the USB plug is not physically

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removed, the image whose projection display operation is in progress is not overwritten by the connection request window until the second period set to be longer than the first period elapses or the user issues an instruction.

Note that the description of the aforementioned embodiment is merely an example, and the present invention is not limited to this. The arrangement and operation in the aforementioned embodiment can be modified as needed. For example, the projector has been exemplified as the display apparatus in this embodiment, but a PDP, LCD, SED, CRT monitor, and the like may be used. Note that "PDP" is an abbreviation for "Plasma Display Panel". Also, "LCD" is an abbreviation for "Liquid Crystal Display". "SED" is an abbreviation for "Surface-Conduction Electron-emitter Display". Furthermore, "CRT" is an abbreviation for "Cathode Ray Tube".

This embodiment has exemplified the arrangement using USB, but the present invention is not particularly limited to this. For example, an SDIO (Secure Digital Input/Output) interface and other interfaces may be used. Furthermore, as an external storage device using a USB mass storage, an SD (Secure Digital) card memory, CF card, and the like may be used.

In the second, third, and fourth modifications, the insertion detector 121, which is a mechanism for detecting a physical contact of the connector, is used as means for detecting a physical connection of the USB plug, but the detection mechanism is not particularly limited. For example, as another means for detecting a physical connection of the USB plug, a current amount that flows through the VBUS line may be measured, and if the measured current amount exceeds a predetermined value, it may be determined that the USB plug is physically connected.

(Other Embodiments)

The aforementioned embodiments can be implemented in a software manner by a computer (or a CPU, MPU, etc.) of a system or apparatus. Therefore, a computer program itself supplied to the computer to implement the aforementioned embodiments using the computer implements the present invention. That is, the computer program itself required to implement the functions of the aforementioned embodiments is one invention of the present invention.

Note that the form of the computer program required to implement the aforementioned embodiments is not particularly limited as long as that program is computer-readable. For example, the program may adopt the forms of an object code, a program to be executed by an interpreter, script data to be supplied to an OS, and the like, but the present invention is not limited to them. The computer program required to implement the aforementioned embodiments is supplied to the computer via a storage medium or wired/wireless communications. As the storage medium for supplying the program, for example, magnetic storage media such as a flexible disk, hard disk, and magnetic tape, optical/magneto-optical storage media such as an MO, CD, and DVD, a nonvolatile semiconductor memory, and so forth may be used.

As a computer program supply method using the wired/wireless communications, a method using a server on a computer network is available. In this case, a server stores a data file (program file) that can be a computer program which forms the present invention. The program file may be either an executable format file or source codes. Then, the program file is supplied by downloading to a client computer that has accessed the server. In this case, the program file may be segmented into a plurality of segment files, which may be allocated on different servers. That is, the server which pro-

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vides the program file required to implement the aforementioned embodiments to the client computer is also one invention of the present invention.

Also, a storage medium, which stores the encrypted program required to implement the aforementioned embodiments, may be delivered, and key information required to decrypt the encrypted program may be supplied to the user who meets a predetermined condition, so as to allow that user to install the program on a computer of the user. The key information can be supplied to the user by making him or her download it from a homepage via, for example, the Internet. The computer program required to implement the aforementioned embodiments may use the functions of an OS which already runs on the computer. Furthermore, some functions of the computer program required to implement the aforementioned embodiments may be configured by firmware which runs on an expansion board or the like attached to the computer, or may be executed by a CPU equipped on the expansion board or the like.

The present invention is not limited to the above embodiments and various changes and modifications can be made within the spirit and scope of the present invention. Therefore, to apprise the public of the scope of the present invention, the following claims are appended.

This application claims the benefit of Japanese Patent Application No. 2008-141678, filed May 29, 2008, which is hereby incorporated by reference herein in its entirety.

The invention claimed is:

1. A display control apparatus comprising:

a communication unit configured to communicate with an external device; and

a display control unit configured to display, on a display unit, an image received from the external device via the communication unit, and if communication with the external device is disconnected, to stop the display of the image received from the external device.

wherein the display control unit varies a period of time from the disconnection to the stopping of the display of the image depending on a type of the external device.

2. The display control apparatus according to claim 1, wherein the display control unit stops the display of the image immediately or after a specific period of time elapses from the disconnection depending on a type of the external device.

3. The display control apparatus according to claim 1, wherein if the communication with the external device is physically disconnected, the display control unit stops the display of the image after a predetermined first period of time elapses.

4. The display control apparatus according to claim 3, wherein if the communication with the external device is logically disconnected, the display control unit stops the display of the image after a predetermined second period of time elapses, the predetermined second period of time being longer than the predetermined first period of time.

5. The display control apparatus according to claim 1, wherein the communication unit is connected with the external device via a physical communication interface.

6. The display control apparatus according to claim 1, wherein the display unit has a lens for projecting an image.

7. A display control apparatus comprising:

a communication unit configured to communicate with an external device; and

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a display control unit configured to display, on a display unit, an image received from the external device via the communication unit, and if communication with the external device is disconnected, to stop the display of the image received from the external device.

wherein the display control unit varies a period of time from the disconnection to the stopping of the display of the image depending on a determination result as to whether the disconnection of the communication with the external device is a physical disconnection or a logical disconnection.

8. The display control apparatus according to claim 7, wherein the display control unit stops the display of the image immediately or after a specific period of time elapses from the disconnection depending on a determination result as to whether the disconnection of the communication with the external device is a physical disconnection or a logical disconnection.

9. The display control apparatus according to claim 7, wherein if the communication with the external device is physically disconnected, the display control unit stops the display of the image after a predetermined first period of time elapses.

10. The display control apparatus according to claim 9, wherein if the communication with the external device is logically disconnected, the display control unit stops the display of the image after a predetermined second period of time elapses, the predetermined second period of time being longer than the predetermined first period of time.

11. The display control apparatus according to claim 7, wherein the communication unit is connected with the external device via a physical communication interface.

12. The display control apparatus according to claim 7, wherein the display unit has a lens for projecting an image.

13. A control method of a display control apparatus having a communication unit configured to communicate with an external device, the method comprising:

a display control step of displaying, on a display unit, an image received from the external device via the communication unit, and if communication with the external device is disconnected, stopping the display of the image received from the external device.

wherein the display control step varies a period of time from the disconnection to the stopping of the display of the image depending on a type of the external device.

14. A control method of a display control apparatus having a communication unit configured to communicate with an external device, the method comprising:

a display control step of displaying, on a display unit, an image received from the external device via the communication unit, and if communication with the external device is disconnected, stopping the display of the image received from the external device.

wherein the display control step varies a period of time from the disconnection to the stopping of the display of the image depending on a determination result as to whether the disconnection of the communication with the external device is a physical disconnection or a logical disconnection.

* * * * *

From: Radsch, Andrew
Sent: Thursday, April 30, 2020 1:34 PM
To: LeGovan, Andy
Cc: Thomases, Andrew; Taylor, Scott; TCL-Canon; Ropes-TCL-Canon-Service; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com; wrlamb@gillamsmithlaw.com
Subject: RE: Canon v TCL, No. 18-cv-546-JRG - Document Production Status

Andy,

I write concerning the portions of your email directed to non-party Roku.

Canon's Request No. 19 requested production of agreements between Roku and others "concerning the TCL Roku TVs," and went on to give examples of such "others." Roku conducted a reasonable search for and produced responsive agreements, subject to its objections. Your email below attempts to rewrite Request No. 19 (mischaracterizing the request as seeking "licenses and related agreements, including agreements that provide Roku with revenue from the use or sale of the accused products"), and correspondingly distorts my representation. I represented that Roku had completed its production of agreements responsive to Request No. 19. It has. Your email also appears to take an improperly expansive view of what it means for an agreement to "concern[] the TCL Roku TVs." The categories of agreements to which you appear to refer do not concern the TCL Roku TVs. Based on a reasonable investigation and search, Roku does not have agreements with channel developers, content publishers, and CDN providers that "concern[] the TCL Roku TVs." What Roku does have is thousands of agreements with channel developers, content publishers, and CDN providers that do not "concern[] the TCL Roku TVs." Such agreements are not responsive to the request and are not relevant or proportional to the needs of the case. Identifying, collecting, analyzing, and clearing any confidentiality restrictions for those thousands of agreements would impose an undue burden on Roku.

Regarding Request Nos. 14 and 16 directed to financial information, Roku collected and produced the financial information it maintains in the ordinary course of business related to the TCL Roku TVs. The financial information produced is that which Roku keeps and tracks in the ordinary course of business as related to the accused products. The additional financial information you appear to be demanding is information Roku does not have, does not keep in the ordinary course of business, and/or cannot ascertain. For example Roku does not track revenues from advertising or subscriptions on a device type basis. Roku is not required to produce information it does not have or does not track. Canon's continued insistence that Roku produce additional financial information—both that which Roku does not have or track, and that which is not directly tied to the sale of an accused product—is not relevant or proportional to the needs of the case, and imposes an undue burden on Roku.

Andrew

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Subject: RE: Canon v TCL, No. 18-cv-546-JRG - Document Production Status

[EXTERNAL]

Andrew,

Please provide an updated status on the TCL Zoom source code and documents relating to sales projections and sales forecasts today (first and second bullet point in my April 22 email). We need to know a date certain by which both of these categories will be complete. Given the schedule, and Defendants' repeated delays in producing relevant documents, we cannot tolerate any further delay. If we do not receive a status update today, with specific explanation of what is being collected and produced, we will be filing a motion to compel.

Additionally, regarding the alternatives documents (third bullet point in my April 22 email), please describe in detail what you mean when you say the production is "largely complete." Again, given the schedule and the delays in Defendants' productions, we will be filing a motion to compel if we do not have a specific status update from you today.

Further, regarding the fourth bullet point in my April 22 email, you represented that Roku has completed its production of licenses and related agreements, including agreements that provide Roku with revenue from the use or sale of the accused products such as channel developer, content publisher, and CDN provider agreements as requested in RFP No. 19. However, we have seen no channel developer, content publisher, and CDN provider agreements in Roku's document production. Such agreements are relevant to the revenue that Roku makes from the accused products, as Roku itself has represented in its 10-K filings: "We license the Roku OS and our smart TV hardware reference designs to certain TV brands to manufacture co-branded smart TVs. The primary economic benefits that we derive from these license arrangements have been and will likely continue to be indirect, primarily from growing our active accounts and increasing streaming hours on our platform." <https://ir.roku.com/static-files/cd9f1b20-16f9-4b68-9438-09cd9c630929> (2019 10-K) at 17. Given the parties are at an impasse on this category, Canon will be filing a motion to compel.

Finally, as we discussed during our lead and local meet and confer on Monday, Roku's production of financial information is deficient. *See* RFP Nos. 14, 16. Therefore, Canon will be filing a motion to compel on this category as well. Canon's subpoena (which, again, was served over four months ago), requested documents relating to Roku's finances with respect to use of the accused products, including specific categories of information:

RFP No. 14: "Documents sufficient to show the quarterly revenue of any collateral or conveyed products or services sold in the United States involving the use of an Accused Product between 2014 and present, including but not limited to: (a) Total revenues (gross and net revenues); (b) Revenues from licensing Roku platform to TCL; (c) Number of active accounts using Accused TVs; (d) Revenues derived from video advertisement played on Accused TVs; (e) Revenues derived from subscriptions of streaming content on Accused TVs; (f) Number of streamed hours on Accused TVs; (g) Number of units sold; (h) Gross margin; (i) Operating costs; (j) Operating margin; (k) Net margin; and (l) Net profits."

RFP No. 16: "All documents relating to the benefits (monetary and non-monetary) You received (or expected to receive) from the Accused Products being sold and used in the United States, including, but not limited to, projected, expected, or actual impact that the Accused Products had on Your sales of other products or services. To the extent possible, the information identified in this request should be broken down by model of the Accused Products."

On Monday's meet and confer call, you represented that the "primary document" Roku produced in response to these RFPs was the financial spreadsheet at ROKU-CANON_0000025253, which only lists number of units sold and some form of revenue, and is missing most of the information that Canon requested, such as number of active accounts using the

accused TV among several others. The spreadsheet lists a total of less than \$3 million attributed to TCL between 2014 and 2019. The \$3 million total that the spreadsheet attributes to Roku's biggest smart TV partner over the course of six years is less than 0.8% of Roku's Platform net revenue that it reported in 2019 alone (\$388 million). <https://ir.roku.com/static-files/cd9f1b20-16f9-4b68-9438-09cd9c630929> (2019 10-K) at 57; <https://www.morningstar.com/news/accesswire/577502msn/tv-brand-streaming-mediaboosts-performance-and-share-prices-of-roku-and-tcl-electronics> ("over 60% of Roku TVs nationwide are TCL Roku TV"). Indeed, Roku received more than that amount in licensing fees from TCL in 2016 alone (as well as in 2017 and 2018). See ROKU-CANON_0000000231.

It is simply not credible that Roku does not keep documentation providing further detail as to the amount of revenue Roku generates from TCL Roku TVs, as Roku must have some means of assessing the value of its partnership with TCL and other TV manufacturers. For example, Roku has stated in its public filings that its business model focuses on increasing the number of active accounts that use its streaming platform. <https://ir.roku.com/static-files/cd9f1b20-16f9-4b68-9438-09cd9c630929> (2019 10-K) at 5. Surely Roku must keep information as to the number of active accounts that each of its TV manufacturer partners generates when this metric is the core of its business. Roku's founder and CEO Anthony Wood has implied that Roku keeps track of such metrics for TCL when he publicly stated at CES 2018 that "[w]orking with companies like TCL is the fastest way we grow our active accounts." TCL-CANON_0000031914 at 31946.

Given the schedule and Roku and Defendants' repeated delays in producing relevant documents, Canon cannot wait until a deposition of a Roku finance witness to find out that Roku has substantially failed to comply with its discovery obligations. Therefore, we intend to bring this issue to the Court right away.

Finally, please also confirm that, aside from the outstanding issues described herein, Defendants, Roku, and TTE's document productions are complete.

Thanks,
Andy

From: Radsch, Andrew <Andrew.Radsch@ropesgray.com>
Sent: Wednesday, April 22, 2020 10:54 PM
To: LeGolván, Andy <andylegolván@paulhastings.com>
Cc: Thomases, Andrew <Andrew.Thomases@ropesgray.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; jdoan@haltomdoan.com; jthane@haltomdoan.com; gil@gillamsmithlaw.com; wrlamb@gillamsmithlaw.com
Subject: [EXT] RE: Canon v TCL, No. 18-cv-546-JRG - Document Production Status

Andy,

Defendants' investigation into source code for the TCL Zoom remote, which you first identified last week and which does not form any basis of your contentions in this case, is ongoing. Defendants are working diligently to run those questions to ground. Regarding your second bullet, additional forecast information was produced yesterday, and Defendants continue to conduct a reasonable additional search. We hope to run both to ground this week. As to your third bullet, Defendants' production is largely complete.

Regarding your fourth bullet, Roku's production is complete.

Andrew

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From: LeGolván, Andy <andylegolvan@paulhastings.com>
Sent: Wednesday, April 22, 2020 1:58 PM
To: Radsch, Andrew <Andrew.Radsch@ropesgray.com>
Cc: Thomases, Andrew <Andrew.Thomases@ropesgray.com>; Taylor, Scott <Scott.Taylor@ropesgray.com>; TCL-Canon <TCL-Canon@paulhastings.com>; Ropes-TCL-Canon-Service <Ropes-TCL-Canon-Service@ropesgray.com>; idoan@haltomdoan.com; ithane@haltomdoan.com; gil@gillamsmithlaw.com; wrlamb@gillamsmithlaw.com
Subject: Canon v TCL, No. 18-cv-546-JRG - Document Production Status

Andrew,

On the April 20 lead/local meet-and-confer call, you agreed to provide a status update by today on the following outstanding document and source code production issues that relate to both Defendants and Roku (where specified). Please confirm you are on track to provide that update today.

- Status of Defendants' production of TCL Zoom remote control source code
- Status of Defendants' production of documents relating to sales projections and sales forecasts of TCL Roku TVs between 2014 and 2024, including projections and forecasts specific to the Accused Products. Recall that you agreed on the call to produce responsive documents for the full timeframe.
- Status of Defendants' production of documents relating to the alternatives Defendants have considered with respect to the accused functionalities and documents relating to the actual or projected costs to the alternatives. As we agreed on the call, this would include, without limitation, alternatives to Roku OS that Defendants considered (e.g., operating systems developed by others, developing their own operating system, etc.), and documents relating to the actual or projected costs to the alternatives.
- Status of Roku's license agreement production and production of related agreements. This would include the status of production of the channel developer, content publisher, and CDN provider agreements that were explicitly requested in RFP No. 19, and other agreements that provide Roku with revenue from the use or sale of the accused products (also covered by RFP No. 19).

Thanks,
Andy



Andy LeGolván | Associate, Litigation Department

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